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" *To the solid ground*
Of nature trusts the Mind that builds for aye "—WORDSWORTH

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P I Dee lecturer in Physics, Miss A C Davies lecturer in Physics, Dr M L E Oliphant assistant director of Research in Physics, Dr W B Lewis demonstrator in Physics, Prof E V Appleton appointed Scott lecturer for 1936-37, H McCombie approved for degree of Sc D , Dr C S Myers elected an honorary fellow of Gonville and Caius College, 1085
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Of nature trusts the Mind that builds for aye"—WORDSWORTH

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Cultural Significance of Broadcasting*

THE speed with which in a decade or so broadcasting has passed from being the interest or hobby of an expert few into the pleasure and recreation of millions has tended to concentrate attention on the purely scientific and technical developments which have made this change possible The reactions of this rapid growth upon the listener himself, the new problems which broadcasting itself may offer, have escaped attention except by a few, and it is only slowly and with difficulty that broadcasting is emerging from the toy stage to that of laboratory and workshop for human culture.

The scientific inquiries into international aspects of broadcasting, which have been initiated by the International Committee of Intellectual Co-operation of the League of Nations, afford an example of the widening field of scientific research and the possibilities, and responsibilities, of what may be termed social research which arise out of technical advance, and are in keeping with those studies of the effect of the cinematograph on education, instruction or national life visualised by the first International Congress on Educational Cinematography in Rome last April. The first of the inquiries set on foot by the International Committee was a survey of educational broadcasting throughout the world The substantial volume which embodies its results contains an authoritative account of experiments, results and projects in twenty-five countries, as a result of which a statement of the leading principles of school broadcasting has been prepared which should be an invaluable guide in further experiment leading to the perfecting of this new method

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* School Broadcasting (Intellectual Co-operation Series.) Pp 208 7s 6d Broadcasting and Peace (Intellectual Co-operation Series) Pp 232. 7s 6d (London George Allen and Unwin, Ltd, 1934)

The inquiry makes it clear that school broadcasting has a place of its own in primary, secondary and higher education, but the technique of its use, the choice of subjects, methods of presentation, manner of incorporation in the general framework of classroom courses, and the full potentialities of the method, are only being evolved Studies of this type are of great assistance in the development of an adequate technique They throw light on the true reasons for failure, and are correctives to its indiscriminate use or rash condemnation

The second investigation was a study of broadcasting in relation to peace, to which indeed a brief section in the first report is devoted The dangers which broadcasting may present in regard to international peace and goodwill have been made plain abundantly by unfortunate incidents between Germany and Austria in the last two years The dangers of the use of this method as a means of political propaganda are less obvious but none the less real, and the report which the International Committee has produced on this question will repay study by all who approach broadcasting in the spirit of scientific inquiry

The third inquiry upon which the International Committee is now embarking relates to the possibilities, problems and methods of cultural broadcasting in its widest sense, and may prove to be the most fundamental and interesting of the three researches The investigation deals with the organisation and contents of programmes and their national and international co-ordination, the possibility of broadcasting university extension courses, the social training of listeners, the announcement of scientific discoveries, instruction in literature and history and the teaching of foreign languages

Studies of this order at once throw into relief the difference between the broadcast to an unseen audience and the lecturer who can see and adjust his lecture to the reaction of the audience in front of him Beyond this there is the development of the precise technique which makes it possible to convey new vistas to a voluntary adult audience, without any suggestion of superiority or of the schoolroom Pooling of experience and ideas on this difficult art is a first step to a scientific technique

It is at least arguable whether the technique of broadcasting will not be ultimately more art than science Unquestionably, however, psychology has an important contribution to make in this field, and at the International Congress of Anthropological and Ethnological Sciences in London last August, Prof T H Pear pointed out several lines of research which still await the attention of psychologists and anthropologists Prof Pear's paper in itself indicates that the psychologist is alive to the problems which broadcasting and the film present As an observer of human experience and behaviour, he cannot ignore the serious disturbance which they both represent in the life of the citizen, and he must attempt to find the reasons for the likes and dislikes which he observes

Problems of this type present in fact a striking field for laboratory work, but as Prof Pear emphasised, with certain special exceptions in regard to school broadcasting and the request for opinions on the broadcasting of drama, practically no systematic research has been carried out in Great Britain into the pyschological and other problems created by broadcasting Little intensive or extensive research even into listeners' likes and dislikes and the reasons for them has been made, and the evidence that those responsible for the provision of radio programmes are really anxious to discover the views of the general public on the material is unconvincing

Prof Pear suggests that this omission is due to the fear that the results of such inquiries would necessitate either a grading up or a grading down of the programmes If this is the correct explanation, such an attitude to research is unworthy of an industry based so fundamentally on scientific research as the broadcasting industry Indeed, this attitude inevitably foreshadows the decay of the institutions or organisations which hold it Change and development cannot be avoided by mere passivity, and if the broadcasting authorities are not prepared to conduct research into these fundamental problems of their art, sooner or later their power and influence will pass into the hands of those prepared to undertake the work and apply its results Nor can society tolerate for long any organisation which does not seek to equip itself continuously to render ever more effective service based on the full, impartial and fearless exploration of the whole domain which it affects to control.

The reports and the papers to which we have referred indicate, moreover, that scientific workers themselves have special interests and responsibilities in this matter. On one hand, the possibilities which broadcasting presents as a means of diffusing scientific knowledge, and also of carrying on that educational work which is so essential if the ordinary citizen is to acquire an adequate general background for the kind of life he is called upon to live in these days, have been neither fully utilised nor explored. Evidence presented in the report on educational broadcasting already indicates a considerable volume of opinion in Belgium, France, Switzerland, Germany and the United States as to the value of broadcasting in relating scientific work to the general interests and activities of the community Scientific workers have yet to seize the opportunities for exposition which here confront them when they have qualified themselves by acquiring the requisite technique.

On the other hand, to the true spirit of science, the fields of investigation touched upon by Prof Pear represent an even greater attraction There could scarcely be found a more inspiring example of the twin responsibility and challenge in respect of social research which the application of scientific discoveries throws down to the man of science himself, than these fields of investigation which now lie before us, in broadcasting and cinematography alike, demanding his close co-operation if they are to be possessed for the welfare of civilisation and not contribute to its undoing

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Reviews

Isaac Newton

Isaac Newton · a Biography By Louis Trenchard More. Pp xiii+675 (New York and London. Charles Scribner's Sons, 1934) 18*s* net

AT last we have an adequate biography of Newton Prof More would not wish us to say it was perfect—that would have been impossible—but he has spent seven years reading the documents and considering them, and he does not hesitate to tell his opinion, even if unfavourable We have got into a period of biography where an unfavourable opinion has rather a preference for expression But Prof More is not that kind of biographer. He has a respect, almost a love for Newton, though far "this side idolatry", and deliberates a long time before he comes to an unfavourable opinion

Newton has fallen into bad hands among his editors and biographers Horsley was a person who did not see the difference of interest that future times would attach to works by Newton and lucubrations by Bishop Horsley Prof. More convicts him of quite definite suppression of documents which he examined, and which would have proved Newton a 'Socinian', or as we now say, a Unitarian Leaving Horsley aside, as too bad to mention, Brewster figures to Prof More in much the same way He, too, suppresses documents that he does not like One must make allowances for him. He presented Newton as *possibly* a *very mild* Socinian, and even then, was rebuked by a bishop for it But he must have got on Prof More's nerves. In fact, he wipes the floor with Brewster, after the presentation of each incident. He was indeed a most unsuitable person A biographer of someone whose greatest period of creation was at the Restoration, and who died more than two hundred years ago, ought to be imaginative, catholic, sympathetic with all and sundry, and Brewster was not that. The other biographers portray one point of view only Edleston seems to be careful and accurate, but has done only a scrap Rigaud's essay is the same The separate contributions to Greenstreet's volume are of very unequal merit, some are valuable, many are by good names, but some are quite off the mark Then there is Lieut-Col de Villamil, who astonished everybody by making no less than four capital discoveries, the chief of them appear to me the actual inventory of all the items which Newton's house contained, drawn up with extreme thoroughness, the actual list of Newton's books, now among the MSS of the British Museum, and an actual statement of his money affairs at his death, including a criticism of any dealings he had in South Sea stock Yet despite the richness of the material, the book in which he published it remains a poor affair

Newton was little understood in his time We cannot wonder. Scientific men are usually little understood, very few people care for pure logic, or are prepared for the surprising consequences, if it is pushed to the uttermost. But besides, Newton was habitually a silent man He was not a ready speaker His notion appears to have been, to say something conclusive and leave it at that, whether it was understood or not This sort of thing does not go to the heart of the ordinary man or woman But women had no influence in Newton's life He began life poor and ended it rich; yet he used no corrupt practices and was generous in giving. Opposition had a very bad effect upon him—for did he not *know* it to be unreasonable? Yet most people would say that he had not more opposition than was good for him, to teach him the sort of world he was in His life was not a pathetic life; he had none of those amiable weaknesses that make us forgive a great deal to Goldsmith and Richard Savage He moved among ordinary men that we can visualise, such as Pepys, Hooke and Oldenburg But all seem to have felt that he was greater than they, and different, and that he required nothing from them Later, this feeling seems to have congealed into a spell, which accompanied him as an unwholesome and impenetrable aura This spell has been the greatest obstacle to acquiring a true view of Newton.

The incidents of Newton's life are indispensable, but only because his theories grew up among them I do not think that the scientific views were much changed by the incidents, but undoubtedly their presentation was His ideas are what matter to us now, the views that have, almost miraculously, kept their shape

I have often wondered why Newton made no capital discoveries in chemistry, which he studied and practised so assiduously, and made absolutely revolutionary discoveries in mechanics and optics. I think I know now The discoveries in optics were made because he was an unusually good experimenter, and knew, after he had "meditated", no man better, the immediate and ultimate inferences that his experiments required The discoveries in mechanics, the laws of motion and the philosophical system on which they are based, are just "meditations", the object being to find something that would stand metaphysically. Metaphysics was the bane of science in those days, but since it cannot be excluded, Newton built a wall, guaranteed to stand any attack, within which his mathematics could operate undisturbed His mathematical theorems in the "Principia", as well as his other very notable contributions to the science, are just inferences—of course *in excelsis*—from stated data But why did he add nothing to chemistry? Chemistry was much studied in Newton's day. Boyle was his friend, and Boyle has given us Boyle's Law Locke, also a friend, was a chemist, even an alchemist. Van Helmont's works are in his library Newton read the unprofitable volumes of the alchemists, I think to ascertain whether he could learn anything from them. In one of his letters, he speaks of them as "great pretenders" I think the phrase is sarcastic, meaning that you get nothing in the end

What then was Newton seeking? I admit that incidentally he was seeking transmutation But he did not find it I cannot believe that he laboured so long in vain There is a great resource if we want to ascertain Newton's undemonstrated ideas, upon subjects on which he had "meditated"—the "Queries" which he attached to the optics Many of the ideas which he had derived from his study of alchemy he put in the long, final query, No 31. Prof More quotes much of this query Reading it through, one sees that Newton was looking for a common basis of all matter, and the mechanism of the transmission of energy and gravitation across space From this point of view, Boyle's Law becomes a mere incident, which might be expected to become almost self-evident But we now know that there is a very long and thorny road to go before we arrive at a common basis of matter. We are scarcely agreed upon it yet, but let that pass Even supposing, what does not seem likely, that Newton had avoided *all* the pitfalls, and would have had nothing to do with a "phlogistic" theory, which proved such a will-o'-the-wisp to chemistry, he would have seen in face of him, beyond gross matter, the immense jungle of the carbon compounds, the molecules, the elements, the atoms of these elements, the structure of these atoms, the positive and negative element of electricity, and finally the quantum The spectrum, even, was unknown to Newton We can scarcely imagine the structure of the atoms being unravelled, apart from the spectrum. Except some astronomical examples, all measuring instruments were exceedingly crude The balances are shown with rough strings to the pans, nor was the dependence of chemistry upon a balance realised. So if we read through Query 31, and say "quite possibly right", we must remember that this rightness is only possible if we think in electricity I understate the task, but actually it was impossible, there was no body of facts such as we have now—for example, the periodic system, the "shoulders of giants" were wanting, from which Newton could look out over the future

At the present time we are surrounded by uncertainties. We must remember that Newton was rooted in certainties—in three at least. These were, the actual words of Scripture, the "geometry of Euclid and Apollonius", and the inferences of logic He was also endowed with a peculiar aptitude of devising and performing experiments. He "meditated" upon their consequences, by which we must understand that he saw, as none other has been able to do, all that they implied. That is the reason why, when he had arrived at a conclusion, he made no allowance whatever for those that questioned it, and at first, when he was a young man and unknown, they were very numerous. Later, when it was enough to say "Newtono suadente", I agree with Prof. More that the deference he enjoyed reacted unfavourably upon his character. Prof. More describes the early paper in which he demonstrated his optical theories to the Royal Society as a "work of art".

This is well said. Newton was an artist, though not in paint or stone. He was, apparently, contemptuously indifferent to any work of imagination. But no one who has read the "Principia", or any of his letters, or even seen his beautiful handwriting and signature, can doubt that he was an artist. He was an artist, because he loved beauty; he thought it the direct expression of the Divine, as it is presented to us. He had moreover the artist's temperament, which showed itself, as it did in Rossetti, in rather overbearing conduct.

We have seen all these grounds of certainty fade away. Geometry went first, because it was in the hands of people who had a common ground, and were able to realise when a theorem was proved. As to the Scriptures, whatever view we attach to the Bible story, we now regard the Bible—for the most part, and subject to some delegation of authority in matters of such importance—as a book among other books, to be examined textually and in substance, confronting different statements to see whether they agree, by any method that the higher criticism may choose to apply, estimating the contents by whether we think the thing did occur or did not. Most people, nowadays, would smile if they were asked to believe in Bishop Ussher's date for the creation, or the ages of the patriarchs, and Jonah's whale.

Now logic seems to have joined the other two on the same road, and to melt away "like wracks in a dissolving dream", and prove just nothing at all. We are told that if we "prepare" an experiment, we prescribe the answer also, which is always *yes*, if the question is not nonsensical. Exit "Q E D", and enter "Sez You".

Now that we can see Newton "in the round", we can form an estimate of his value, apart from what everybody knows and has known for two hundred years—that he was an incomparable genius in both theory and experiment. Roubillac was a great artist, and has caught most admirably in marble the expression which we can attach to his "meditations"—"the index of a mind forever voyaging through strange seas of thought, alone". Certainty was the note. Experiment, and inference, and experiment again—that was the indispensable key to progress; and a very good key it has proved, supposing "progress" is what we want, for it has made scientific men, where they are not leaders of the modern world, at any rate necessary authorities on all the things that other people want to answer and cannot.

But in deifying Newton, as he has been, rather grotesquely, deified up to the present, we must think of Lieut.-Col. de Villamil's "Inventory", and his list of books. Most people will read them with astonishment; it is possible some may comment "Stuffy old house. Not a single valuable piece of furniture. Crimson, a bad note. Stuffy old books. Not a single book of verse among them except those that he may have read at school. Not a single live book, except Galileo's 'De Systemate Mundi'. No Copernicus. No Kepler." They will issue from it with relief. There is no doubt that Newton appears in these authentic, if unsentimental, documents as a limited person. Nowadays we rather distrust certainty. We doubt whether we are the people to handle certainties, if someone would point one out. Besides, their field is too narrow, and we have found that we can learn all we want to know from most regions by a few well-chosen experiments, and by the general bearing of the replies. To speak of geniuses alone, Shakespeare represents much more the kind of man who might tell us something we wanted to know. You find profundities among his words, but mixed up with guffaws and sniggers and the interjections of people who just happened to be by and were certainly not profound and had no wish to be. "We are such stuff as dreams are made on, and our little life is rounded with a sleep." Would you put an automatic pistol into the hands of a dream person? He might dissipate the dream.

R. A. S.

Hamites and Semites

Semitic and Hamitic Origins, Social and Religious. By Prof. G. A. Barton. Pp. xvi+395. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1934.) 17*s.* net.

MORE than thirty years ago, Prof. Barton wrote a book on Semitic origins when he was very strongly under the influence of Robertson Smith. Owing to the strides which have been made in the study of the prehistory of Egypt and western Asia since that date, Prof. Barton now confesses, quite frankly, that there is scarcely a topic of importance in his earlier work—such, for example, as totemism, descent and marriage among the early Semites—upon which he has not had reason entirely to change his views.

Prof. Barton now attacks Hamitic and Semitic origins once more, moving on a wide front which embraces linguistics, ethnology, archæology, social anthropology and religion. In his view that the nations of western Asia were of a very mixed character, most prehistorians will concur, but they would also point out that the evidence upon which he relies is mainly linguistic and cultural, and does not necessarily imply wide differences in racial strain.

In regard to the origin of the Hamites and Semites, the view here put forward by the author is that the Semites were one branch, the early Egyptians being another, of a stock which originated in North Africa, possibly in the Sahara They crossed to southern Arabia, and there developed their peculiarly Semitic characteristics A later fission led to the further differentiation of the northern Semites, who are usually regarded as the purest representatives of the race The occurrence of a strong brachycephalic element in the southern parts of the peninsula is held by Prof Barton to be due to the fact that this territory long served as a passage-way for commerce and racial movement, so that an alien element partially submerged the older dolichocephalic strain These are the brachycephals whom Sir Arthur Keith identifies as an intrusion of broad-headed people from the north, akin to, but not identical with, the Armenoid, holding that it is more nearly related to the broad-headed element, presumably from Central Asia, which appears in parts of India

In his racial and cultural analysis of early Mesopotamian civilisation, Prof Barton attaches much importance to what he characterises, somewhat vaguely, as a central Asiatic people, regarding the Sumerians as relatively late It is to be noted, however, that Dr Dudley Buxton, in his study of skulls from Kish, while recognising the existence of a broad-headed element in the early population, has expressed doubts as to whether the brachycephals from the Asiatic highlands penetrated the Mesopotamian area to any great extent in the earlier phases of its civilisation In attributing the prehistoric culture of the Indus valley to his central Asiatics, Prof Barton seems to ignore the trend of evidence which points in an increasing degree to a cultural connexion with western Asia

In dealing with social and religious origins, Prof Barton traces further the differentiation between the early Egyptians and the Semites He shows how the peoples, or rather tribes, who entered the Nile valley when driven from what is now the Sahara by desiccation, brought with them animal cults and totemic beliefs, which afterwards developed into the various animal cults of the Egyptian nomes and later into the Egyptian pantheon The Semites, on the other hand, elaborated as the characteristic expression of their beliefs a fertility cult, of which the central motive was the union of the male and female deities and its principal observance two seasonal festivals, one in spring and the other at harvest The institution of temple prostitutes and cognate observances, once interpreted by the author as evidence of an early state of sexual promiscuity and polyandry, he now accepts as part of the fertility cult In following Sethe's recent work on the totemic character of the cults of the Egyptian nomes, the author adopts a view which was advocated by Andrew Lang many years ago and accepted by the late Prof A H Sayce, though this fact is not noted

The interest of Prof Barton's work in its reference to the racial problem has precluded detailed consideration of his study of questions relating to other aspects of social institutions and religious beliefs In particular, his views on the origin and development of the Yahweh cult and the growth of monotheism among the Hebrews tempt discussion which space does not permit

Unfortunately, it is necessary to close on a note of criticism In dealing with the argument from physical anthropology, Prof. Barton fails to maintain the level of his scholarship in other fields It cannot be said that he has mastered his material, nor does he appear to be acquainted with the most recent literature, such as, for example, Buxton's later work on the material from Kish and Miss Garrod's more recent results which reveal a population of mesolithic age in Palestine resembling the predynastic Egyptians Misprints and errors in this section of the book are innumerable "Meyers" for Myres, "Sir *Charles* Keith", "Borm" for Bornu, and "Miss Caton-Thompson" when Miss Garrod is intended, may be slips, but they suggest a lack of the familiarity with the literature, necessary for a study of this character, which would correct them almost automatically

Standard Analytical Reagents

'Analar' Standards for Laboratory Chemicals being Improved Standards for the Analytical Reagents formerly known as 'A R' Pp xvi+295. (London British Drug Houses, Ltd, and Hopkin and Williams, Ltd., 1934)

IN 1914, when chemists found themselves deprived of the usual Continental supplies of laboratory reagents, a joint committee appointed by the Institute of Chemistry and the Society of Public Analysts drew up specifications to ensure a sufficient degree of purity in eighty-eight chemicals of importance in analytical work Reagents of this quality were distinguished by the letters "A R". This useful action was taken merely as a War-time emergency measure, and has not been continued by the two societies.

The letters "A R." acquired considerable prestige in this connexion and it is unfortunate that, as is implied in Prof J. F Thorpe's interesting foreword to this book, they should have lost their original significance by uncontrolled extension of their application. Chemists are not entirely without a remedy for this state of things. The British Pharmacopœia 1932, and the British Pharmaceutical Codex 1934, between them provide standards for practically all the materials used in medicine These include a large number of chemicals and it is only necessary to add the letters "B P" or "B P C" to a requisition for one of these products to obtain it of the standard quality Specifications for chemicals of industrial importance are also being gradually produced by the British Standards Institution and the few so far dealt with can be obtained of the prescribed quality by use of the letters "B S S" Chemists might do worse than familiarise themselves with these three sets of authoritative standards and make use of them, where they meet their requirements

These standards do not, however, cover the whole field, and there is still need for a modernised and extended set of specifications corresponding to the original "A R" list Thus, the growing importance of micro-methods of analysis and the improvements in technique, which make it possible to determine with reasonable accuracy small fractions of a milligram, are creating entirely new requirements, both in kind and quality of analytical reagents For such work it is all-important that the operator should know the degree of purity of each reagent he has to use

This kind of information is provided for two hundred and twenty chemicals in the book before us The more important physical properties of each product are recorded, the methods of assay and the processes used for the determination of impurities are given, briefly, but with ample details, and the maximum limits of all likely impurities are stated The two firms concerned are well known as makers of laboratory chemicals and have each published books of specifications for these products They still manufacture independently, but have pooled their technical information and unified their methods of analysis and their specifications for the chemicals dealt with in this joint publication, an enterprise on which they are to be congratulated They have also registered jointly the trade-mark "Analar" to distinguish the products they manufacture in conformity with these specifications This action protects both the manufacturer and the consumer against the kind of deterioration which is said to have overtaken the standards implied by the letters "A R"

Short Notices

This Modern World and the Engineer Pp 140+18 plates. (Edinburgh Royal Scottish Society of Arts, 1934) 5s net

A GROUP of five distinguished engineers and one equally distinguished physicist has given us a concise and popular, although none the less authoritative, account of modern developments and trends in engineering The book is essentially a presentation of the Keith lectures for 1933 of the Royal Scottish Society of Arts With one exception, the authors are professors in the University of Edinburgh, hence the lectures "may be said to express the views of the Edinburgh School of Engineering on the tendencies in the several branches they treat" Prof C G Darwin, Prof A R Horne, Sir Thomas Hudson Beare, Prof F G Baily, Dr R Lessing and Prof H Briggs survey the fields of physics and of mechanical, civil, electrical, chemical, and mining engineering, showing us, with apt illustration, how directly and completely life in this modern world depends for its very existence on mechanism and its human control

This volume, however, does more than offer information; it places before us some of the world's major social problems, and leaves the layman—What more ingratiating way of evading responsibility has been discovered than this of calling one's self a layman ?—with a brainful of thoughts to weave into his economic and political creed Prof. Briggs, in his "Extrapolation", shows that present-day engineering rests on a non-ethical basis, but he calls upon the engineer to consider questions of rights and consequences, and at a stride to identify himself professionally with his responsibilities as a civilised human being The engineer could make war difficult by disqualifying from membership of powerful professional institutions all connected with the manufacture of arms Organised control of industry could classify new inventions or processes as work-making or work taking, and exploit them accordingly for the greatest good Estimates relating to such processes should include consequences arising outside the factory walls These and other matters which are presented for our thoughtful consideration remind us how illusory is the barrier now between technology and sociology A. A. E.

A Soldier in Science the Autobiography of Bailey K Ashford Pp v+425+4 plates (London George Routledge and Sons, Ltd, 1934) 12s 6d net

COL BAILEY KELLY ASHFORD, of the United States Army Medical Service, died on the day on which his autobiography was published His work in scientific medicine falls into two main parts, hookworm and sprue In 1899 he found hookworm eggs in the fæces of anæmic Porto Rican peasants, and by mass deworming lowered the island's mortality from anæmia by 85 and increased the peasant's working capacity by 60 per cent He recognised that the worm was not the well-known Old World hookworm, but it was left to Stiles to designate it *Necator americanus* In 1933 Ashford illuminated acute hookworm infection by his description of a small epidemic acquired during sea bathing During the War his main charge was the command of the school at Langres for the battle training of American medical officers He was awarded the D.S M and Honorary C M G , and the Grand Cordon of the Order of the Nile, and was appointed editor in-chief of the United States Medical History of the War He was instrumental in founding in Porto Rico an Institute of Tropical Medicine and Hygiene, and in arranging for its expansion into a School under the auspices of the Columbia University, New York After experience of 4,000 cases of sprue he concluded that the essential factor in its causation was unbalanced diet, and that when to this was added infection by *Monilia*, of which he recognised only one species, there resulted sprue He unswervingly advocated and fruitfully practised that combination of clinical observation and scientific investigation which has strikingly advanced tropical medicine CLAYTON LANE

Thoughts of a Schoolmaster (or Common Sense in Education) By H S Shelton Pp 256 (London . Hutchinson and Co (Publishers), Ltd , n d) 6*s* net

THE strength of this book lies in the rich variety of its author's experience As a boy he was in four schools, and as a master in twenty five, including public, grammar, co educational, private, proprietary and technical schools Not that by nature he was a 'rolling stone', but that by necessity he was transferred from place to place during the War He deals only with secondary schools, and he touches many topics, including the 'unpopularity' of schoolmasters, the tradition of the headmaster, salaries, co education, discipline and so on , and whether one agrees with him or not, his criticism is always practical and to the point, and it is often constructive.

On the subject of science teaching, Mr Shelton condemns the general neglect of biology, and suggests, as a practicable reform, advanced courses in biology, with interchange between neighbouring schools, and special attention to biology in country schools He pleads also for universal courses in general science, not, however, made up of scraps of chemistry and physics and biology and geology and astronomy merely strung together, but conceived as a single subject with many interrelated divisions. The author is not, and probably does not claim to be, free from the charge of dogmatism But he writes with knowledge, at a time when our secondary school system is very far indeed from being above criticism.

The Principles and Practice of Surveying By Prof C B Breed and Prof G L Hosmer Vol 2 *Higher Surveying* Fourth edition Pp xix + 603 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1934) 21*s* 6*d*. net

ALTHOUGH this work is an American publication, it deals with its subject in such a way as to be as suitable to students as most of the well known English books thereon It is extremely well set out and lucid in style, and includes such modern developments as those of geology in relation to topography, and aerial photography as applied to surveying A most useful set of problems is appended at the end of each section, but it is unfortunate that the answers to these are not given

With the increasing use of precise levels, fuller details relating to the parts of such instruments could have been given with advantage, while the reproduction of the photographic illustrations is not up to the standard of the letter-press It would not be usual in Great Britain to expand the portions relating to the flow of water in channels to so great an extent, these constituting a chapter generally found in large works on hydraulics.

The size and method of binding is evidently designed for field use , in its general tenor, the work can be confidently recommended to students who are preparing for engineering degrees of honours standard, and to all who are interested in the subject.

B H. K

Progress of Archæology By Stanley Casson Pp. xii + 111 + 24 plates (London G Bell and Sons, Ltd , 1934) 6*s* net.

MR CASSON surveys progress in archæological discovery during the last fifteen or twenty years throughout the world, dividing it into nine main archæological provinces His purpose is to touch upon the most significant discoveries or excavations in each and to bring out, where such consideration is appropriate, their interrelation Mr Casson's book is pleasantly and easily written and well illustrated ; but on even the most generous interpretation of the lines upon which a book of this kind can be written for an educated but non-technical public, it is far too sketchy The treatment of Africa, even including Egypt, and of America, for example, is quite inadequate, in view of recent work in both continents The first chapter, on the aims and methods of archæology, is by far the best, though it shows some confusion of thought, and the definition of the field of archæology not only begs the question, but also is contradicted by the pages which immediately follow.

Practical Plant Anatomy · an Elementary Course for Students By Comyns J. A Berkeley Pp 112 (London · University of London Press, Ltd , 1934) 3*s*

A GOOD practical guide to elementary botany is sorely needed, and this book by Mr. Comyns Berkeley will fill part of the gap , the practical plant anatomy is dealt with, and this is done extremely well. The author is obviously conversant with the practical side of botanical study, for he not only gives clear directions as to methods of approach but he also gives hints of difficulties—sometimes slight, but irritating—that are constantly cropping up. Another problem that students and even teachers are constantly meeting is that of sources of material. Few books give the reader any idea of where to obtain their type specimen Mr. Berkeley gives sufficient help in a series of tables. This is very useful.

It is a pity that the author did not go a little further and cover completely an intermediate science course in botany.

Immigration of Insects into the British Isles

By DR C B WILLIAMS, Chief Entomologist, Rothamsted Experimental Station

ABOUT a hundred years ago, it was gradually dawning on British entomologists that many of the butterflies in this country might be immigrants from abroad Among the species first suspected of this habit were the Clouded Yellow (*Colias croceus*) and the Pale Clouded Yellow (*C hyale*) It is curious that about the same time a more practical controversy was commencing in the United States as to whether one of their most serious pests, the cotton worm (*Alabama argillacea*) was a permanent resident of that country, or not To-day we know that not only these early disputed species, but also many other Lepidoptera, dragonflies, and some members of other groups of insects, regularly migrate, and that in a number of cases these movements come to an end in the British Isles, thus giving the insects in question the status of 'immigrants'

In the study of migration it is possible to start from two points of view We may study a single insect throughout the whole range of its migration An example of this is seen in an account that I gave of the migration of the Painted Lady butterfly (*V cardui*) in NATURE of April 11, 1925 (p 535) This is, in my opinion, the most fruitful method of investigation The alternative is to study the migration phenomena of all insects as seen within a limited area By this method it is easier for a single investigator to take field observations, and easier to obtain the co-operation of voluntary helpers, but it must always be remembered that the results are only a group of incomplete phenomena, the basic causes of which must often be sought elsewhere

Most insect migrations in temperate zones consist of movements in the spring from sub-tropical or warmer zones towards the cooler parts of the temperate zone with—sometimes at least—a return southward in the autumn Since the British Isles are in the cool temperate zone, it follows that they will figure chiefly as an end point for spring migrations and perhaps, more rarely, as a starting point for autumn movements

Among the insects which come into Great Britain in this way in the spring are to be reckoned about twelve of our sixty-six butterflies, about half our Hawk moths (Sphingidæ), quite a large number of other moths, including even some Tineidæ less than an inch across the wings , at least a dozen of our dragonflies, and an occasional errant locust. It may also be necessary to add to the list certain Coleoptera, Aphidæ and Syrphidæ (hover flies), which are occasionally washed up in great numbers on our shores after a storm, but at the moment the evidence is too fragmentary to distinguish between wilful migration and accidental distribution by wind

Some of these species do not breed at all in Great Britain, some breed only during the summer and die out each winter, while others breed regularly and continuously here, but are reinforced at intervals from abroad Some immigrants arrive regularly each year, while others come only at intervals of several years, or in very varying numbers Many only invade our southern shores and the counties along the coast , others, especially in years of great abundance, may spread as far as the north of Scotland and the Orkney and Shetland Isles Some cross the English Channel conspicuously by day in large bands, whilst others appear to cross by night or individually and have never been recorded actually during the movement

Turning in more detail to what is known of some of the species five of our immigrant butterflies, the Monarch (*D plexippus*), the Camberwell Beauty (*V antiopa*), the Bath White (*P daplidicæ*), the Long Tailed Blue (*L boeticus*) and the Queen of Spain Fritillary (*A lathonia*) do not breed in Great Britain , the Clouded Yellow (*C croceus*), the Pale Clouded Yellow (*C hyale*), the Painted Lady (*V cardui*) and the Red Admiral (*V atalanta*) breed regularly during the summer but seldom, if ever, survive a winter while the three Cabbage White butterflies (*Pieris brassicæ*, *rapæ* and *napi*) are regular residents as well as irregular immigrants

Most of these butterflies come to us from the more southerly parts of Europe in the spring or early summer, but there are some exceptions to this rule The swarms of Cabbage White butterflies appear to originate in the Baltic area and fly about midsummer southward through Germany and westward across the North Sea and the Netherlands The Camberwell Beauty arrives almost exclusively in the autumn along our eastern shore, even as far north as Inverness, and probably comes from Scandinavia The Monarch butterfly is unique in coming to us in the autumn from the west across the Atlantic In the United States at that time of the year enormous flocks are migrating southward, and our immigrants are probably wanderers blown out of their path and helped across by the prevailing westerly winds

Finally, the Painted Lady comes to us from the south, but there is reason to believe, as already pointed out in my earlier article in NATURE, that our immigrants may come from as far afield as North Africa, if not farther

Among the Hawk moths, the Death's Head (*A. atropos*), the Oleander Hawk (*D. nerii*), the

Silver-Striped (*C livornica*), the Striped Hawk (*H celerio*), the Convolvulus Hawk (*H convolvuli*), the Bedstraw Hawk (*C galii*), the Spurge Hawk (*C euphorbiæ*) and the Humming-Bird Hawk (*M stellatarum*) are all immigrants which do not normally survive the winter in Great Britain, though most of them may breed during the summer of immigration The status of the Privet Hawk and the Pine Hawk is not definitely settled All the immigrants come from the south, but practically nothing is known of their origin except that some most certainly reach their maximum abundance in early spring in North Africa

Information about the smaller moths is scattered and uncertain Definite immigrants include the Silver Y moth (*Plusia gamma*), the Rush Veneer (*Nemophila noctuella*), the Satin moth (*L salicis*), the Crimson Speckled (*D pulchella*) and many others The Diamond Back moth (*P maculipennis*), a small but serious pest of crucifers, is believed to cross the North Sea, while one of the most widely distributed pests of cotton, the American Boll Worm (*Heliothis armigera*), is a rare immigrant in Great Britain, where it boasts of the popular name of the "Scarce bordered Straw"

The British dragonflies include a dozen immigrants, all belonging to the Anisopteridæ Some of these are only very rare wanderers, others, such as *Sympetrum fonscolombii*, *S flaveolum* and *S sanguineum*, are more regular immigrants, while *Libellula depressa*, *L quadrimaculata* and *Aeschna grandis* breed here regularly and are also immigrants at times No member of the family Zygopteridæ has yet been considered an immigrant in Great Britain

Apart from the details of which insects migrate, when they migrate and where they start from, there are a number of general problems connected with this subject, chief among which is the question of a return flight or emigration in the autumn towards the south in those species which arrive from the south in the spring Until recently, there was little evidence in support of this, and zoologists were inclined to think that insect migration was therefore fundamentally different from that of birds However, little by little, evidence is accumulating that makes it seem that a return flight, at least of some species, does take place Particularly is this so in the case of the Red Admiral butterfly (*V atalanta*) for which we have now quite a number of records of small autumn movements to the south on our shores, while in the case of *V cardui* an ornithologist has reported their arrival on several occasions on the North Egyptian coast at dawn, flying in from across the Mediterranean along with the migrating quail. It is important to recognise, in collecting evidence on this point, that a migration need not be a gregarious action, and we know of one butterfly, the Monarch of North America, which carries out a movement in one direction gregariously and in the reverse direction individually

Other problems requiring solution, which can only be settled by long continued collection of facts, are the reasons why one or other sex (more often the male) should frequently predominate in a flight, or if there is any periodicity connected with the movements, and how the insects keep to their fixed direction On the last point there seems to be not the slightest clue, but it might be as well to point out that the evidence in hand lends no support to the oft-quoted theory that insects fly at a definite angle to the wind Flights, on the whole, are as often with the wind as against it, and while there are one or two cases known of a change of wind resulting in a change of flight direction, there are very many more records of flight direction remaining constant in spite of frequent changes of wind

In the past, the collection of records on the immigration of insects into Great Britain has been entirely haphazard Scattered through the pages of a dozen entomological and natural history journals of the past century are records of sudden abundances, unexplained absences and occasionally of clouds of butterflies crossing the English Channel or arriving on the shores of Great Britain But the absence of records for several years means little or nothing but a period of lack of interest However, a little more than three years ago the South-Eastern Union of Scientific Societies formed an Insect Immigration Committee under the energetic secretaryship of Capt T Dannreuther This Committee has organised a widespread system of district recorders, has issued a list of insects about which information is specially needed, and has sent out some thousands of standard record cards to voluntary observers in all parts of the country The results have so far surpassed expectations, and have thrown new light on the movements of certain butterflies, particularly the Common Whites and Red Admiral Now also the Committee has obtained, by permission of the Trinity Brethren, the co-operation of a number of keepers of light-ships and light-houses round the coast, and the records they are sending in are adding to our knowledge of many previously known migrants, and suggesting new and unexpected insects that will require watching in the future

The study of insect migration in Great Britain is now better organised than it has ever been before, and far more completely than anywhere else in the world; but many additional helpers are needed, and years of work and co-operation from the Continent will be necessary before a definite answer can be given to any of the outstanding problems

Institution of Electrical Engineers' Library of Sound Films

THE Institution of Electrical Engineers is collecting a library of sound films made by eminent electricians and electrical engineers It is hoped that they will be of interest not only to subsequent generations but also to many local centres of the Institution overseas Sound films have already been taken of Sir J J Thomson, Sir Ambrose Fleming, Mr W M Mordey and others After being introduced by the president of the Institution, the speaker makes a short address giving a review of the progress made in electrical science or engineering from his earliest days and sometimes trying to foretell the trend of development in the future We have pleasure in printing below the address given by Sir Oliver Lodge for this library

* * *

I have lived from the very beginning of the electrical age that is now upon us When I was young there was no such thing as a dynamo If we wanted a current of any magnitude, say for instance to supply an electric arc, we had in those days to mess about with a Grove's battery, consisting of zinc, platinum and acids, and it was a troublesome business I remember that the name 'dynamo' was invented by Lord Kelvin in a paper before Section A of the British Association, when I was a secretary to that body

I remember seeing the original Pacinotti machine, which soon developed into the Gramme armature , and then ingeniously the Siemens firm introduced a double-winding and made the modern Siemens armature , there had been an old Siemens armature, with an iron rail wound longitudinally, which was shown at the 1862 Exhibition producing strong currents, and exciting much interest It was no easy matter to get a really strong current in those days covered wire was almost a novelty, while to make connexion between different things there was no notion of plugging in two terminals , we had to screw up each wire with a binding screw , a pair of binding screws were the only terminals

I remember the first electric lamp shown to the Telegraph Engineers by Mr (later Sir Joseph) Swann, which he said would serve well for a reading-lamp, and not require any matches for its lighting up And a little later I remember Colonel Crompton coming for one of the conversaziones at University College, London, and bringing a number of such lamps, which he arranged in the entrance hall, festooning them as an exhibition He came himself and superintended the erection with extraordinary energy, taking possession of Carey Foster's laboratory, and having it all rigged up in time

I remember too the first visit of Graham Bell and his demonstration of the telephone at South Kensington, when he lectured to the Physical Society in a most beautifully articulate manner, pronouncing everything completely and accurately He was just the right type of man to make a metal disc speak

Then Hertz made a great advance , he discovered how to produce and detect waves in space , thus bringing the ether into practical use, harnessing it for the transmission of intelligence, in a way which has subsequently been elaborated by a number of people

Now, this present century, which has made many undoubted discoveries in physics, seeks to discredit and deny the ether of space , and I want to conclude this talk by a few words upholding its reality It is the ether which conveys waves in the fraction of a second to the antipodes, it is that which brings us information from the stars and the most distant nebulæ, which otherwise we should be without The ether is the seat of all radiation energy and indeed of all other energy, whether it be in the form of light or other waves I remember when the nature of light was not known Clerk Maxwell's great paper dated from the year 1864 or maybe '65, when I was just leaving school and was not awake to its magnificence I did not know of it till the 'seventies , but in 1873 his great book on electricity appeared, and that year I attended my first meeting of the British Association, at Bradford, and heard it spoken of This was a book worthy to be mentioned in the same breath as the "Principia"

Newton and Maxwell are among the glories of the human race and they did for the ether something magnificent which has not been surpassed by any work of man The ether is the vehicle of gravitation and of light Its theory is not complete even yet We are still groping after their great and unfinished discoveries Einstein has shown us something more about gravitation, and has done away with action at a distance , and Planck has discovered the law regulating the interaction of ether and matter, so that radiation is only produced and destroyed in discontinuous quanta. But interference shows that radiation and the ether are continuous in free space, and that quanta only make themselves evident at the beginning and end of radiation—at the generation and absorption of light—when the ether is associated with the discontinuous thing that we call matter.

I have here indicated what will be the work of the twentieth century, to complete the theory of the ether and to show how all things lead to an intelligible and concrete reality, very different from the abstractions and confusions under which we now, for the time, labour. Yet the present is a phase through which we had to go: it is an intermediate era in physics, through which we are guided by great men, Eddington and Jeans and Dirac, men who are contributing a great deal to physics and astronomy, work which we could not do without, and which forms a necessary avenue to the clear open space beyond.

Before the end of the twentieth century, as I think, or at any rate in the twenty-first, the ether will be recognised as the one means of communication between the atoms, and the whole of physics will become once more luminous and clear, constituting a glorious epoch for our descendants. The ether will come into its own again, not only for practical purposes as the seat of all potential energy, but with a clear understanding of it as the one substance that holds the universe together, in which all matter is embedded, without which even locomotion cannot be properly understood, and which constitutes the physical vehicle for life and mind. OLIVER LODGE.

Scientific Centenaries in 1935

By Eng. Capt. Edgar C. Smith, O.B.E., R.N.

GLANCING back once again over the history of science during the last few centuries with the object of recalling those men of science whose centenaries occur during the coming year, it is but natural to turn to the early records of the Royal Society.

In these, over and over again, is found the name of Robert Hooke, who was born on July 18, 1635, three hundred years ago. A scholar of Westminster School and a graduate of Christ Church, Oxford, he became the friend of Wilkins, Boyle, Wilkins, Seth Ward and others. On November 12, 1662, he was appointed curator of experiments to the Royal Society and on June 3, 1663, was elected a fellow of the Society. Two years later he was made professor of geometry in Gresham College, and it was in his apartments in Gresham's old mansion in the City of London that he passed the greater part of his life. A long list of papers and experiments testify to his ingenuity and versatility, and no doubt in due course tribute will be paid to his memory. "As to his Person," said Benjamin Martin in his "Biographia Philosophica", "he made but a mean Appearance, being very small and somewhat crooked; but he had an active, penetrating, indefatigable Genius, sparing no Pains in Quest of the Truth in Relation to whatever came under his Consideration." Hooke died on March 3, 1703 and was buried in St. Helen's Church, Bishopgate, a church which probably has more associations with the Royal Society than any other.

Two contemporaries of Hooke's abroad were Johann Becher (1635–1682) and Christoph Sturm (1635–1703). Becher was one of the first chemists to cast off the mystical language of the alchemists, and in his writings can be found the germ of the phlogiston theory. He wrote much, travelled widely, and only a short time before his death came to England to visit the Cornish mines. Sturm, who was also a German, was professor of physical science in the University of Altdorf, and is remembered as an advocate of the teaching of science in schools. In their day, Germany was slowly recovering from the inconceivable miseries of the Thirty Years War, during which, it is said, the population fell from 20,000,000 to 4,000,000.

It was in 1635 in the midst of that war that Wilhelm Schickard (1592–1635) and Johann Faulhaber (1580–1635) died. The latter was an able mathematician who was acquainted with Descartes, while the former was known to Kepler and to Gassendi. It was to Gassendi that Schickard sent his observations of the transit of Mercury of 1633.

The work of these scientific worthies belongs almost entirely to the seventeenth century, a period during which, says Cajori, the progress of physics was truly extraordinary. During the eighteenth century, he says, physics proper was cultivated by men of more limited powers than those of Galileo, Huygens and Newton. For all that, however, there was great activity in various branches of science, especially in mathematics and astronomy, and in England practical astronomy made wonderful advances.

To these advances a succession of clever mechanicians contributed, and of all the British men of science born two hundred years ago none has a more interesting record than Jesse Ramsden (1735–1800), who from a clothworkers' apprentice at Halifax rose to be the leading instrument maker in London. "Esteemed by the great, cherished by his friends and loved by his servants and workmen", Ramsden was called by Delambre "le plus grand de tous les artistes". From Ramsden's shop in Piccadilly came some of the finest telescopes and theodolites. He was elected a fellow of the Royal Society in 1786 and nine years later was awarded the Copley Medal for his "Various Inventions and Improvements in Philosophical Instruments". Another instrument maker of note was John Coventry of Southwark, who was born in the same year as Ramsden but outlived him by twelve years.

The year 1735 also saw the birth of Gregorio Fontana (1735–1803), for many years a professor of mathematics at Pavia and Milan; of Charles Auguste Vandermonde (1735–1796) the French mathematician and chemist who had much to do with founding the Conservatoire des Arts et Métiers; of Hugh Williamson (1735–1819) of Philadelphia, who was one of the observers of the transit of Venus of 1769, and also of the chemists Keir and Bergmann.

James Keir (1735–1820) began life in the army, but in 1768 settled at West Bromwich and devoted himself to chemistry, geology, glass-making and the writing and translation of scientific works. He was a friend of Erasmus Darwin, Watt, Boulton and Priestley, joined in the monthly meetings of the Lunar Society, and from 1785 onwards was a fellow of the Royal Society. Tobern Olof Bergmann (1735–1784) was for a long time professor of chemistry at Uppsala. "He was," said Senier, "the first to perform chemical analysis systematically and laid the foundation of that art." At his death the Academy of Sciences of Stockholm had a medal struck to commemorate his work.

Bringing the survey a century nearer to our own time, to the year 1835, there is a considerable list of deaths and a longer list of births to be recognised. This part of the survey may well begin with Edward Troughton (1753–1835) who, like Ramsden, came from the north to achieve distinction as a London instrument maker. He also was a fellow of the Royal Society and a Copley medallist. His shop was in Fleet Street, and astronomical instruments of his making went to Greenwich, Paris, the Cape, Cracow, Brussels and elsewhere. Airy described Troughton's mode of graduating arcs of circles as "the greatest improvement ever made in the art of instrument making".

Astronomy is also represented by Dr. John Brinkley (1763–1835) sometime Bishop of Cloyne. Born in Suffolk, he was senior wrangler in 1788 and four years later became Andrews professor of astronomy in Trinity College, Dublin. He also became the director of Dunsink Observatory and was the first Royal Astronomer of Ireland.

Another Copley medallist who died in 1835 was Capt. Henry Kater, one of the earliest workers on the trigonometrical survey of India. Ill-health brought him back to England and after further service in the Army, in 1814 he was placed on half-pay, from which time he devoted himself to science. He was well known for his accurate pendulum experiments and his study of standard weights and measures, and, had his life been prolonged, his services would undoubtedly have been used in connexion with the replacement of the British standards destroyed in the burning of the Houses of Parliament in October 1834.

Physics is also represented by Leopoldo Nobili (1784–1835) of Florence, who invented the thermopile afterwards used with great skill by J. D. Forbes and Melloni.

To this record of men of science who passed away a century ago may be added the Irish geologist, John MacCulloch (1773–1835), who abandoned medicine for the study of the rocks and became geologist to the Trigonometrical Survey; Gilbert Thomas Burnett (1800–1835), the short-lived professor of botany in King's College, London; the great French surgeon Baron Guillaume Dupuytren (1777–1835), who from the humblest ranks raised himself to the position of the foremost surgeon in Europe, but, falling sick, refused to permit an operation upon himself, preferring as he said rather to die at the hand of God than of man; Thomas Charles Auguste Dallery (1754–1835), a French pioneer of steam navigation and screw propulsion, and lastly Sir Edward Banks (1769–1835), who with his partner, William John Jolliffe (1774–1835), built Waterloo, Southwark and London Bridges, and was the principal contractor of his day.

As the frontiers of science are extended, and its territories enlarged, so does the number of explorers ever increase. Of those who have made notable contribution to science and have passed away in recent times, the columns of NATURE, since its foundation in 1869, contain biographical sketches of many hundreds, and by the aid of these it is possible to recall briefly some of the outstanding men of genius and talent who were born a century ago. Foremost among these, perhaps, must be placed the distinguished American astronomer, Simon Newcomb, who was born on March 12, 1835, and died on July 11, 1909. Loewy, writing in NATURE of May 4, 1899, said: "Newcomb must be considered without contradiction as one of the most celebrated astronomers of our time, both on account of the immensity of his work and the unity of view which marks the choice of the subjects treated by him".

Two days after Newcomb was born in Nova Scotia, Giovanni Virginio Schiaparelli, the Italian astronomer, was born in Piedmont. Schiaparelli died just a year after Newcomb, on July 4, 1910. The English astronomer, Sir William Huggins, had only recently passed away and on July 5, 1910, the *Times* wrote, "As Huggins stood at the head of English-speaking astronomers, so Schiaparelli stood at the head of the astronomers on the Continent."

Another astronomer who was born a century ago was Friedrich August Theodor Winnecke (1835–1897), whom Sir David Gill called "the greatest teacher of practical astronomy since the days of Bessel", and another, Jean Charles Rudolphe Radau (1835–1911), who though German by birth spent most of his life in France and at the time of his death was a member of the Paris Academy of Sciences and the Bureau des Longitudes.

Chemical science of the nineteenth century is represented by Adolph von Baeyer (1835–1917), August Dupre (1835–1907), Rudolph Fittig (1835–1910) and Johann Wislicenus (1835–1902). All were of German birth, but Dupre became a naturalised Englishman and as such held important Government posts. Fittig, von Baeyer and Wislicenus all received the Davy Medal of the Royal Society. One of Fittig's earliest appointments was to the University of Tubingen, and it was in 1871 that Sir William Ramsay, then a youth of nineteen wrote home: "I go regularly to Fittig's lecture at 8. He lectures very distinctly and clearly. It is really very beautiful to see the way the organic compounds are arranged." Of the career of Wislicenus, and of the charm of his character, much is contained in the memorial lecture delivered in 1905 to the Chemical Society by W. H. Perkin, Jr.

The progress of science is furthered by many means, and this is illustrated by comparing the careers of the three physicists Joseph Stefan of Austria, Elisha Gray of the United States and George Carey Foster of University College, London, who were all born in 1835. Stefan by his researches furthered our knowledge of liquids and gases, light and sound and electricity, and his name is now recalled by the Stefan-Boltzmann law of radiation. Gray was a practical electrician with more than sixty patents to his credit, and though originally a professor he was afterwards connected with manufacturing. It will be remembered that on February 14, 1876, he lodged a caveat for a telephone with the American Patent Office only a few hours after Alexander Graham Bell had visited the office on a similar errand. Carey Foster, on the other hand, although a contributor to scientific literature, was known for the part he played in furthering the best interests of University College, in supporting the claims of women to university privileges and in extending the use of physical laboratories in the teaching of science.

It need scarcely be said that this list of men of science born in 1835 who were devoted to physical subjects could be made longer, but it is perhaps unnecessary to do so. Finally, therefore, attention is directed to the names of one or two distinguished naturalists whose centenaries occur this year. Of these, Alexander Agassiz (1835–1910), the son of Louis Agassiz, was for a time superintendent of the well-known Calumet and Hecla Copper Mines, Lake Superior, but was best known for his work as a zoologist and oceanographer. Born at Neuchâtel, Switzerland, he accompanied his father to the United States in 1846, and there he passed the remainder of his life, holding important positions and taking part in many scientific expeditions. Another naturalist connected with North America was Joseph Frederick Whiteaves (1835–1909), who was born at Oxford and worked there under John Phillips. A visit to Canada in 1861, however, led to his studying the geology of Quebec, and he became palæontologist, zoologist and assistant director of the Geological Survey of Canada. In 1907 he was awarded the Lyell Medal of the Geological Society of London. Of Sir Archibald Geikie (1835–1924) it is but necessary to recall that he was in turn director of the Geological Survey of Scotland, Murchison professor of geology and mineralogy in the University of Edinburgh and director of the Geological Survey of the United Kingdom. He was born on December 28, 1835 and died on November 10, 1924.

Obituary

PROF. B. H. BUXTON

BERTRAM HENRY BUXTON was the eldest son of Mr. Charles Buxton, M.P., of Fox Warren, Cobham, Surrey. He was born in 1852 and was educated at Eton. He entered the business with which his family was associated, but did not find it congenial. Preferring travel, he was a frequent visitor to the United States, on one of his visits, medicine attracted him. Having voluntarily undertaken duty on board a passenger vessel in quarantine because of cholera, he followed up his observations through the Health Officer of the Port of New York, who introduced Buxton to bacteriology. At Cornell he studied in the Post Graduate Laboratory and rapidly became proficient. His keen mind quickly appreciated medicinal science. The University gave him a doctor's degree, and finally he occupied the chair of bacteriology.

Buxton's work was outstanding, his technique brilliant, no detail was too small for his scrutiny or attention. He was among the first to recognise the differing strains of typhoid bacillus in culture; he made notable contributions to the study of erysipelas and typhoid fever, and at the Memorial Cancer

Hospital developed Dr Coley's vaccine of erysipelas for the treatment of inoperable sarcoma He made fine histological preparations and developed a remarkable skill in microscopic pathology and photomicrography He pursued these morphological studies until his voluntary retirement in 1912

Returning to Surrey, Buxton lived at the Manor House, West Byfleet, at the foot of the hill on which is situated his parental home From 1922 he worked as a guest in the laboratory of the Royal Horticultural Society With the late Dr F V Darbishire he studied the effect of varying hydrogen ion concentrations on the colour pigments of plants It was always a great pleasure to watch Buxton at work—so neat and precise in his methods, so keen was his observation of every colour change. His work with Darbishire was reported in the Royal Horticultural Society's *Journal* and in the *Journal of Genetics* Buxton was also keenly interested in genetics and he raised a cross between *Digitalis purpurea*, the purple foxglove, and *Digitalis ambigua* As the result of doubling of the chromosome complement, this hybrid became fertile and has now been recognised as a new species, *D mertonensis* He collaborated with the cytologists at Merton in these investigations, particularly with Dr C D Darlington and the late Dr Newton Other genetical work concerned the Wisley blue primrose and *Primula acaulis*

Buxton keenly felt the loss of his colleague Darbishire, who died in 1932, and his visits to the laboratory became more infrequent. A year or so ago he visited Devonshire and decided to live there He survived his brother Earl Buxton, who was a year younger, by two months Like him, he was also keenly interested in birds, and on his walks over the Surrey commons and in the woods he derived much pleasure from observing the pheasants and the antics of jays and activities of green woodpeckers His charm of manner and courtesy was shown to all, his modesty even prevented his colleagues from learning much of his earlier work, but his wide and varied research has established his reputation in two continents M A H T

WE regret to announce the following deaths·

Prof Arthur Brožek, professor of genetics in the University of Prague, known for his work on plant breeding, on November 8, aged fifty-two years

Dr Otto Folin, professor of biological chemistry in the Harvard Medical School, an authority on the technique of urine analysis, on October 26, aged sixty-seven years

Prof R Koveshgethy, professor of cosmography and geophysics in the University of Budapest, an authority on seismology, on October 12, aged seventy-two years

Miss Rosalie B J Lulham, lecturer in natural history at the Froebel Educational Institute, and author of "An Introduction to Zoology through Nature Study", on December 28

News and Views

New Year Honours

THE following names of scientific workers and others associated with scientific interests appear in the New Year Honours List *Baronet* Sir Holburt Waring, president of the Royal College of Surgeons *G C B* Sir Josiah Stamp. *K C M G* Lieut -Gen Sir William Furse, director of the Imperial Institute , Dr A C D Rivett, deputy chairman and chief executive officer of the Council of Scientific and Industrial Research, Commonwealth of Australia *Knights* Dr C V Boys, for services to physics , Prof W Langdon-Brown, regius professor of physic, University of Cambridge , Dr E Deller, principal of the University of London , Dr. Cyril Fox, director of the National Museum of Wales , Dr J B Orr, director of the Rowett Institute for Research in Animal Nutrition, Aberdeen , Prof E B Poulton, honorary life president of the Royal Entomological Society of London, and emeritus professor of zoology in the University of Oxford ; Dr J D. Sutherland, lately assistant forestry commissioner for Scotland, member of the Forestry Commission. *C.B* Col H. St J L Winterbotham, Director-General of Ordnance Survey, Ministry of Agriculture and Fisheries. *C.M.G.:* Lieut -Col. C L. Carbutt, Chief Native Commissioner, Southern Rhodesia , Prof. F. L. Engledow, professor of agriculture, University of Cambridge, and member of the Colonial Advisory Council of Agriculture and Animal Health , Lieut -Col S P James, medical officer and adviser on tropical diseases, Ministry of Health, and member of the Colonial Advisory Medical Committee *C I E* Rai Bahadur Daya Ram Sahni, Director-General of Archæology in India *C B E* . Dr. E J Allen, secretary of the Marine Biological Association of the United Kingdom and director of the Plymouth Laboratory ; Mr C C Hawkins, lately superintendent of the Department of Technology, City and Guilds of London Institute , Dr J S Plaskett, director of the Astrophysical Observatory, Dominion of Canada *O B E* Mr G W Austin, principal scientific officer, R N Torpedo Factory, Greenock , Mr R W Harris, secretary of the London School of Hygiene and Tropical Medicine *M B E* Dr Alice E. Wilson, assistant invertebrate palæontologist, Department of Mines, Dominion of Canada

Heavy Water in Chemistry

THE lecture by Prof Polanyi which is published as a Supplement to this issue of NATURE directs attention to some of the applications which may be made of heavy water in elucidating the mechanism of chemical reactions The heavy water may be either the variety containing heavy hydrogen in place of ordinary hydrogen, or that containing heavy oxygen in place of ordinary oxygen, and the distribution of the heavy atoms among the products of reactions will indicate the part played by water in them. The striking difference in chemical properties between heavy hydrogen and ordinary hydrogen is due very largely to the differences in zero-point energy, which Prof. Polanyi calls permanent energy, the existence of which is predicted by the new quantum theory. It is possible to calculate this energy, and the results of the calculations may be checked by measurements of equilibria in which the two sorts of hydrogen participate. These experiments are in agreement with the theory. Exchange of heavy hydrogen from heavy water may occur with other compounds, such as benzene, and the mechanism of hydrogenation in ordinary reactions can also be followed in such experiments. The use of nitrogen and carbon isotopes is likely to prove important in the future.

Future of the Sulphur Industry

A PAPER by M. P. Applebey, published in *Chemistry and Industry* of December 28, on recent developments in the chemistry of sulphur, foreshadows important advances and perhaps far reaching changes in those industries which are concerned with sulphur and its oxide. Researches extending over some years in the laboratories of Imperial Chemical Industries, Ltd., at Billingham have solved the problem of concentrating sulphur dioxide from metallurgical gases containing from three to seven per cent, by the ingenious method of using a sulphite bisulphite system which can be regulated to have a moderately high pH in the cold and a much lower one when hot by the addition of a substance such as aluminium chloride, the hydrolysis of which is much increased by rise of temperature. It has been further discovered how to reduce the practically pure sulphur dioxide so obtained by coke

$$SO_2 + C = CO_2 + S$$

The reduction takes place very rapidly and almost completely at 1100° C and is exothermic. It is considered possible to convert economically the sulphur dioxide in dilute furnace gas on the large scale into sulphur, and since this can be transported at about a tenth of the cost of sulphur dioxide and a fifth of the cost of sulphuric acid, the process may be expected to alter radically the economic aspect of sulphur dioxide disposal.

THE metallurgical industries are at present forced to make sulphuric acid to get rid of the sulphur dioxide they produce, and the disposal of this acid locally causes great difficulty, and limits the size of the smelting plants. All these troubles will largely disappear if sulphur is produced instead at one centre. Dr. Applebey visualises a new rationalisation of the metallurgical industries based on pyrites which will enable the sulphur, the non-ferrous metals and the iron to be separated at or near the port of arrival. With the new process, the manufacture of sulphur from anhydrite or gypsum becomes practicable, and lastly, the process reopens in a much more favourable manner the perennial question of the possibility of recovering the sulphur from coal. The discoveries outlined are probably the most important which have been made in the heavy chemical industries for some considerable time.

The Christmas Day Empire Broadcast

FOR the third year in succession, the British broadcasting programmes on Christmas Day included a special hour during which greetings were exchanged with various parts of the world. This year the major portion of the programme came from the countries of the Empire; the Dominions, India and Southern Rhodesia each contributed one or more scenes representing different phases of their national lives. Twenty-five different scenes were presented, and the programme was notable for the accuracy of the timing and the rapidity with which the various connexions were made in succession. It was not a steady tour round the world as was the case on a former occasion; rather had it the air of a random selection of individuals in such places as Australia, Ireland, South Africa, Canada and so on. A broad outline of the technical arrangements by which the programme was carried out was given in the issue of *World Radio* of December 21. In order that so many different programme sources may be blended together to form a homogeneous whole, rapid and silent switching arrangements must be provided by means of which each item may be faded into the next without a break. This is made possible by the dramatic control panel, which was originally designed by the B.B.C. to provide silent and speedy switching between a number of studios in a production of a radio play. It is a simple step to adapt the use of such a panel to the switching of long distance telephone circuits, whether these be land line or radio.

FOR the purpose of the Christmas Day programme, control of fifteen channels was required, and for this purpose a recently developed dramatic control panel was brought into action at Broadcasting House. The panel is so long that it has been necessary to provide a sliding seat for the producer to keep all the controls within reach. The collection of the individual items of the programme was made along circuits connecting Broadcasting House with the Post Office International Telephone Exchange at Faraday Buildings. This exchange is connected with the radio telephone transmitting and receiving stations at Rugby and Baldock respectively, which daily handle the normal commercial radio telephone traffic with all parts of the world. The whole programme as thus assembled at Broadcasting House was radiated through all the B.B.C. transmitting stations, including three Empire short-wave stations, while various relays were made over the local networks in different portions of the Empire. This broadcast provided simultaneously a tribute both to the very high standard of modern communication technique, and to the excellence of the organisation and international co-operation which are so necessary for its success.

Radio-telephone Link from Scotland to Ireland

THE experiments of the Post Office engineers with ultra-short wave radio-telephony links across the Bristol Channel have already been mentioned in these columns During December, transmitting and receiving stations were installed in Scotland and Ireland with the view of providing in the New Year six radio telephone channels in the wave-length range 4-5 metres The *Times* reports that shortly before Christmas, however, the ordinary submarine telephone cables broke down, and three of the new radio links were brought into operation by the postal authorities in order to maintain the telephone traffic between the two countries The positions of the wireless stations are at Enoch Hill, near Portpatrick, on the Scottish side, and Ballywater, near Belfast, on the Irish side The sites were specially chosen on account of their height and freedom from obstruction, and at both places there are ample facilities for extension This wireless link has already dealt successfully with a number of telephone calls from all parts of Great Britain to Ireland, and the callers have, without knowing it, been taking part in an important experiment in wireless telephony An antenna array is used at each station to concentrate the radiation into a beam in the desired direction, and the telephone communication may thus be regarded as secret for most practical purposes The development is of particular interest to Scotland, because of the possibility of applying the system to link up many districts in the Western Isles that are at present isolated so far as telephone communication is concerned The laying of submarine cables is very expensive, and it is likely that the radio link will provide the means of linking up many districts on the west coast at very much lower cost.

A Radio Beacon at Southampton

THE coasts of the British Isles are already equipped with a number of fixed radio beacons, which frequently and automatically emit characteristic signals for the use of ships fitted with radio direction-finders Such beacons are found to be of great assistance to marine navigation, particularly during foggy or stormy weather According to the Southampton correspondent of the *Times*, an agreement has now been reached between Trinity House, the Cunard White Star line and the Southampton Harbour Board, as a result of which a radio beacon will be installed on the Nab Tower for the benefit of ships using Southampton Harbour. This tripartite agreement provides for the sharing of the cost of installation and maintenance of the beacon, which, however, will be owned and operated by Trinity House, the authority to which all similar fixed beacons in Great Britain belong. The decision to carry out this new installation is particularly opportune, as the Compagnie Générale Transatlantique has just decided that, in future, all its westbound steamers from France to America will call at Southampton.

British Empire Air Mails

SIR PHILIP SASSOON, speaking in the House of Commons recently, outlined fresh proposals for the development of Empire air communications These, he stated, represent His Majesty's Government's considered scheme, but are necessarily provisional until the other Empire Governments concerned have examined them There are three main features: an improvement on present time schedules, an increase of frequency of service, and the automatic transfer of all first-class mail to air transport The new proposals envisage a time of seven days to Australia and four days to the Cape, with proportionate times for intermediate places This will be made possible by progressive development of ground organisation to enable night flying to operate over the whole of the routes There will be possibly five services a week to India, three to Singapore and East Africa, and two to Australia and South Africa respectively It is hoped to keep the charge the same as the present Empire rate of 1½*d* by reducing the permissible weight to half an ounce It is suggested that correspondence covering eight sides of a special light paper can be sent within that limit The new services will cater for passengers as well as mail The completion of the negotiations, provision of the necessary fleet, ground organisation, etc, will take at least two years, and the Postmaster-General has stated that there is little possibility of the introduction of the new postal rate before 1937

150th Anniversary of *The Times*

ON January 1, 1785, *The Daily Universal Register* began publication as a modest news sheet at the price of 2½*d* The journal was intended, in the first place, as much to advertise the Logographic Press, set up by John Walter near Printing House Court or Yard, Blackfriars, as to function as a newspaper The title of the paper soon became *The Times*, which now celebrates its one hundred and fiftieth anniversary by the publication of a supplement of thirty pages, in which the history and activities of the paper are surveyed During the past century and a half, both the technique of printing and the art of news gathering and presentation have been revolutionised, largely through the progress of scientific developments *The Times* was printed at first on hand-presses, which turned out about 250 copies an hour. On November 29, 1814, the steam printing machine developed by Friedrich Koenig (1774–1833), was used, which immediately increased the output to more than a thousand copies an hour Since then progress has been rapid and speeds of 40,000 copies an hour are now in use. On the side of news gathering, progress has been even more spectacular. In the early days, foreign news came mostly from foreign journals. Nowadays, all the channels for rapid communication opened up by science are utilised to the utmost. Correspondents are appointed in the principal cities throughout the world or sent specially to places of interest, from which the latest news and reports are transmitted, by telegraph and radio, in word and picture By demonstrating the practical utility of modern methods of rapid conveyance of news and equally by recording scientific developments wherever they occur, *The Times* has played a noteworthy part in the rapid progress of the past century

Rural Conditions in Roman Britain

A NOTABLE addition to our knowledge of the conditions of farm life in Roman Britain is made by the account of an excavation of farm buildings in Carnarvonshire carried out by Mr B H St J O'Neil on behalf of the Office of Works, which is described in the *Times* of December 29 The site is on Caerau farm, north of Pant Glas station, in an area which has already afforded evidence of similar cultivation sites, evidently parts of a rural group or community centring on the Roman fort of Segontium, at Carnarvon, and in which the ancient field system of terrace cultivation can still be readily discerned Of a succession of four ancient farms along the hillside, facing the west, one is practically intact Within what is described as an excellent system of ancient fields, rising one above another, are two separate courtyard houses, of which the first is an oval about 100 ft long, bounded by a stone-faced wall of earth or turf It was approached by a cobbled road 8 ft wide, which passed through an opening in the wall into the courtyard On this yard two rooms now open, but originally there were four These rooms are circular, the larger having a diameter of 25 ft Their structure is interesting The walls are now 4 ft high and may never have been higher The roof was supported by six posts, for which the holes remain, mid-way between the wall and the centre of the building, where there may also have been a post The room was provided with a stone bench on the west side, drains and a trench which may have been a slot to receive a wooden partition, dividing the room into two The smaller hut, which also had a system of drains and gulleys, apparently was used for industrial purposes, the find of a crucible and two hearths suggests the reduction of metals The second house on the edge of the field system has a polygonal boundary wall with a well-defined entrance and at least five rooms around the courtyard One room appears to have had a ridge roof The numerous pottery fragments are typical Romano-British of the second and third centuries A D

The Vertebrate Evolutionary Tree

FOR long we have accepted as well-established and equivalent the five classes of vertebrate animals, but recent zoological research, particularly on the palæontological side, has modified many old conceptions of relationship and suggests that there may be need for readjustment in the major groups An attempt at a new classification which will give due weight to recent discoveries has been made by G. Säve-Söderbergh (*Arkiv. zoologi*, 26, No 17, 1934). Its main suggestions are that the present class Pisces is a medley of two of the three main stocks of Gnathostomes and parts of a third one. This third stock (Choanata) gave rise to the higher vertebrates, but probably by two routes, the ancestors of the Dipnoi leading to the Urodela, of the Crossopterygii to the Anura by a devious route. The Amphibia also must be looked upon as a mixed assemblage, which includes the two stocks just mentioned, but also an offshoot of the reptilian Reptiliomorpha, the Anthracosauria. Finally, birds and mammals belong to a richly branching part of the vertebrate phylogenetic tree, most of the branches being grouped as reptiles, while two equivalent branches are given unequal status as the independent classes Aves and Mammalia The author regards it as absurd that equal systematic value should be given to these classes as to the fundamental group Pisces composed of two entire stocks of Gnathostome vertebrates, and half of the third stock The writer's first reaction to this interesting and revolutionary view of vertebrate phylogeny, in which birds and mammals are grouped with reptiles and Anthracosauria as equal divisions of the Reptiliomorpha, is the thought that systematic classification is not entirely a matter of equivalents, and that even when phylogeny is known, weight must be given to outstanding novelties in evolution which have originated decisive lines of development Thus the 'invention' of warm-bloodedness, which by adding to the adaptability of vertebrates has enabled them to conquer land surfaces far beyond the reptilian range, seems worthy, in association with the structures which made it possible, of a distinctive classificatory label

Starlings in London

FOR some years, enormous numbers of starlings have taken to roosting on the ledges of buildings in central London, where they spend the winter nights in safety on such buildings as the National Gallery, Somerset House, St Paul's and Covent Garden In Edinburgh, similar hordes frequent the roof ledges of the General Post Office and other buildings in the neighbourhood The winter population of starlings in large towns must be unbelievably large, yet it appears still to be increasing In the report for 1933 of the Committee on Bird Sanctuaries in Royal Parks (England), C S. Bayne states that in 1933 (for the first time) starlings roosted on Duck Island in St James's Park without an interval In the first week of May, when winter roosts are usually deserted, he counted there eight thousand of them, but the numbers were greatest in autumn before the usual contingents moved in November to take up their winter quarters in Trafalgar Square It is a matter of some interest to know whence come the starlings that flock to London at night, and R. W. Hale has discovered one of the sources He has watched the birds feeding on and near Hendon Sewage Farm, and has seen them leave there in flocks about two hours before sunset. The flight of the flocks he has tapped at Cricklewood Lane, Finchley Road Station, Lord's and Baker Street Station. A line drawn through these points and extended passes through Trafalgar Square, so the slightest deviation from this would bring them over St. James's Park, and some of the largest flocks which settle in St. James's Park come from that quarter.

(Continued on p. 27)

Supplement to NATURE

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Heavy Water in Chemistry*

By Prof M Polanyi, University of Manchester

Conflicting Definitions of Isotopy

ONE gram is the weight of one cubic centimetre of water at 4° C One cubic centimetre of heavy water weighs about 10 per cent more, that is, 1 1 grams. The molecule of heavy water is composed of hydrogen and oxygen, in the same proportion as that of ordinary water , two hydrogen atoms being united with one oxygen atom Nor is there anything unusual about the oxygen atom in this heavy water molecule But the hydrogen is different from ordinary hydrogen Its atomic weight is 2 instead of 1, and to this new sort of hydrogen all the heaviness of heavy water is due

It is this heavy hydrogen, discovered by Prof H C. Urey in New York, which interests chemists in heavy water At first sight, this interest may well seem unjustified Heavy hydrogen is not a representative of a new class of substances It is to be considered as an isotope of hydrogen, which is accompanied by it in the same way as almost every element is accompanied by one or more of its isotopes Lead, for example, which is mainly constituted of atoms weighing 208 units, contains in addition atoms of weights 203, 204, 205, 206, 207, 209 and 210 In chlorine there is, beside the main part consisting of atoms of weight 35, another kind of atom weighing 37 which forms as much as one third of the element

The discovery by Soddy, more than twenty years ago, of the existence of isotopes, and the disclosure by Aston, with his mass-spectrograph, of the isotopic composition of the elements, were great discoveries But in the years 'that have followed, new isotopes have ceased to arouse general interest, and even when, more recently, the three basic elements of organic chemistry and of living matter, carbon, oxygen and nitrogen, were found to contain a fair amount of heavier isotopes, namely, a carbon of weight 13 beside that of weight 12, nitrogen of weight 15 beside that of weight 14, oxygen of weight 18 beside that of weight 16, these discoveries did not arouse much interest among chemists Indeed, many excellent chemists of my acquaintance have taken no notice of these new isotopes

Why, then, is the new isotope of hydrogen viewed so differently from other isotopes that some chemists consider its discovery to be possibly the greatest advance in chemistry made in this century ? The answer is, because it does not behave as an isotope at all So much so, that Prof Soddy, the discoverer of isotopy, has, in contradiction to the general view, actually repudiated its claim to be regarded as a true isotope Prof Soddy upholds the original definition of isotopy, according to which two elements should be called isotopes if they cannot be separated from one another by any chemical means By this standard, the two different hydrogens should certainly not be considered as isotopes Heavy hydrogen is easily separable from ordinary hydrogen. Water containing 95 per cent of heavy water is available, not as a natural product, but manufactured, by Imperial Chemical Industries Ltd in England, from ordinary water which contains only 1/4,000 of heavy water. Evidently, a very effective separation of the heavy hydrogen from the ordinary one has been carried out in this case. Also there is no doubt that the process used for the separation is a chemical one

The preparation consists in a process of electrolysis The first indications of the separability of the two hydrogens by electrolysis was discovered by the late Dr. E. W Washburn and Prof Urey, who found that when water is decomposed by electrolysis, the undecomposed residue has a somewhat greater density than ordinary water. The purification of heavy water on this basis is due to Prof.

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* Friday evening discourse at the Royal Institution, delivered on November 23

G. N. Lewis of California, who has shown that by decomposing very large quantities of water until only a small residue remains, almost pure heavy water is obtained.

There is plenty of other evidence for chemical differences between ordinary and heavy water. Generally, the compounds of heavy hydrogen react more slowly than the corresponding ordinary hydrogen compounds. The greatest difference has been described by Prof. Urey in the reaction between water and aluminium carbide, which leads to the formation of methane. Heavy water reacts twenty times more slowly than ordinary water.

Why, then, if the two hydrogens are so different, do chemists generally agree to consider them as isotopes ? The answer is, because the two hydrogens, although chemically different, are true isotopes with regard to the structure of their atoms.

The amplification of the original definition of isotopes implied in this opinion is the natural outcome of the theory of Rutherford and Bohr on atomic structure. We can illustrate this structural view of isotopy by comparing the atomic models of the two sorts of hydrogen atoms. These are shown in Fig. 1 according to Bohr's theory. The two atoms are equal in every respect, apart from the difference in the masses of their nuclei. Two atoms thus related to one another are considered to be isotopes from the structural point of view.

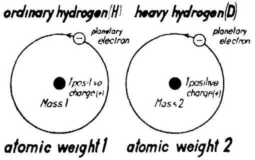


FIG. 1. The isotopes of hydrogen.

Until the discovery of heavy hydrogen, atoms which have the same structure, and differ from one another only in the mass of the nucleus, have always been found to possess identical chemical properties.

It is easy enough to show reasons why this should be so. The forces originating from an atom are due to the electric field of the charges contained in it. Two atoms with identical electric charges, identically distributed in space, will therefore originate identical forces. It is therefore to be expected that such a pair of atoms should have equal chemical properties.

The astonishing thing is that this should not hold for the two sorts of hydrogen atoms, that these two, although giving rise to identical forces, should have different chemical properties. How can the mere difference in nuclear mass cause such marked chemical differences as shown by the two hydrogens ? If mass differences can cause such disparities, why have they never become apparent in other known pairs of isotopes—why has this mass effect remained undisclosed up to the discovery of heavy hydrogen ?

Only when we can answer these questions fully, shall we be quite justified in considering heavy hydrogen as an isotope of ordinary hydrogen.

Now there is a certain difference in chemical properties caused by mass differences, well known for a long time, which we must expect to find more accentuated between the two sorts of hydrogen atoms than between any other pair of isotopes known hitherto. This difference has its origin in the motion in which all particles around us are kept by the *heat* contained in matter. The thermal velocity of a lighter particle is greater than that of a heavier one. A particle moving faster will reach a molecule with which it might react faster than its slower competitor ; it will therefore be found to react more quickly, just as light hydrogen reacts more quickly than heavy hydrogen.

The chemical differences which arise from thermal velocities will depend on the *ratio* of the atomic masses. This ratio is certainly more marked in the case of the two hydrogens than in any other element. It is 1 : 2 for the hydrogens, while in the element coming next to these, namely, the pair of lithium atoms of mass 6 and 7, there is a ratio of only 1 : 1·2. There is thus a good *prima facie* case for attributing the chemical differences between the hydrogen isotopes to their different thermal velocities.

However, this explanation, although it looks so promising at first sight, turns out on closer examination to be an incorrect one. First, calculation shows that the differences in thermal velocities are quite insufficient to account for the differences which have been actually found between the reaction velocities of the two hydrogen isotopes. Secondly, there are some dissimilarities to be described presently between the compounds of the two hydrogens, which prove that these compounds differ in their *energy content*. Consideration of thermal velocities cannot account for such energy differences.

We must, therefore, postulate a cause apart from the differences in thermal velocities, for the explanation of the actual dissimilarities of the two sorts of hydrogen. We shall see that this cause is to be found by applying to our problem one of the more recently discovered principles of Nature, namely, the uncertainty relation of Heisenberg.

THE LAW OF UNCERTAINTY

The uncertainty principle states that no information can be obtained about the velocity of a particle the position of which is known with absolute accuracy. *Certain* information about the velocity can be arrived at, if we admit a *certain inaccuracy* of position. Thus, the two inaccuracies remain tragically linked together in the formula

Inaccuracy of position × inaccuracy of velocity = constant.

Our information on position and velocity has in it a compound inaccuracy which is irreducible.

From this uncertainty, however, we can derive a dynamical principle latent in all matter, which acts against a force holding a particle, and in doing so modifies the effects of the force. It will also appear that the effect of this dynamical principle depends on the mass of the particle, and is, therefore, different for two atoms giving rise to identical forces, but differing in mass. We shall then see that this is the true reason why the two hydrogen atoms are so different.

A fictitious experiment will enable us to recognise the dynamical principle in question. Suppose we attempt to defeat the uncertainty principle by sheer force. We take an atom and hold it at rest in some fixed position. If we succeed in doing this, we would obviously overthrow the law of uncertainty. The position of our atom would be exactly known and, since we suppose it to be held at rest, its velocity would also be known to be exactly equal to zero.

The law of uncertainty predicts that our experiment will fail. Any force trying to keep an atom in a fixed position would be defeated by a power given to the particle to defend its uncertainty. It will defend it by starting to vibrate. The tighter we try to hold the atom to stop this vibration, the more violent would the vibration become. No force would be strong enough to keep the particle in place, motionless.

The uncertainty law thus leads to the following postulate: Any particle restricted to a definite range of positions is necessarily in motion; the range of velocities contained in this motion will be the wider, the narrower the restriction of positions; that is

Range of positions × range of velocities = constant.

In Nature, atoms are restricted in their position when linked up to chemical compounds. Such restrictions, we must conclude, will give rise to an uncertainty motion of the atoms. All molecules will hence contain a certain amount of uncertainty motion, and also, since this motion has kinetic energy attached to it, a certain amount of corresponding energy. We might also postulate that the more restricted the positions of the atoms in the molecule are, that is, the stronger the bonds that hold the atoms in position, the more violent will be the uncertainty motion, and hence the greater will be the energy content of the molecule, due to uncertainty.

Next to bond strength, atomic mass will influence the uncertainty motion. This influence of mass is contained in the constant of the uncertainty formula, which can be written

$$\text{Range of positions} \times \text{range of velocities} = \frac{\text{universal constant}}{\text{mass}}.$$

Thus the composite uncertainty on the left hand side of the equation is smaller the larger the mass of the particle. Hydrogen of mass 1 will have a compound uncertainty twice as large as hydrogen of mass 2. Under equal conditions, therefore, the uncertainty motion and the energy of this motion will be larger for light hydrogen than for heavy hydrogen; in corresponding molecules containing the two sorts of hydrogen, there will be more 'uncertainty energy' present when the molecule contains ordinary hydrogen than when it contains the heavy isotope.

Compare, for example, ordinary water with heavy water. For ordinary water, the 'uncertainty energy' amounts to 13,097 cal.; for heavy water it is only 9,527 cal. Since the uncertainty energy is only present in molecules, and vanishes when the atoms are set free, it follows that less work is needed to break up an ordinary water molecule into free atoms than to separate the atoms of heavy water. This is illustrated graphically by Fig. 2. From such differences in the energy contents of the corresponding molecules, all the differences in the chemical properties of the two hydrogens arise I will show this in the remaining part of my lecture, but before turning to this, I wish to emphasise two points First, that the attribution of the exceptional dissimilarity of the two hydrogen isotopes to the exceptionally high ratio of their masses is not correct Suppose a lead isotope should be discovered having double the mass of ordinary lead Such an isotope would be chemically indistinguishable from ordinary lead, because the 'uncertainty' attached to a particle of the mass of a lead atom is imperceptible, and hence no variation of this uncertainty can be detected Secondly, the permanent character of the atomic motion, which is required to keep up the uncertainty of velocities, should be clearly realised Atoms and molecules are ordinarily kept in, what may seem to us, perpetual motion by heat But heat can be passed on to a cooler body, or be lost altogether by radiation In the distant future, all heat may become lost by radiation, and all thermal motion may die out But beyond that death, the uncertainty motion will persist for ever No atom bound in a molecule can ever find rest from this motion, nor lose the energy arising from it We might well call this the *permanent motion*, and the energy corresponding to it the *permanent energy* of the molecule

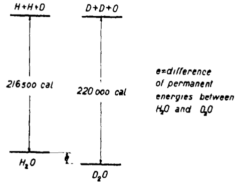

H+H+O
D+D+O
216500 cal
220 000 cal
e=difference of permanent energies between H_2O and D_2O
H_2O
e
D_2O

FIG 2

PERMANENT ENERGY AND CHEMICAL PROPERTIES OF THE HYDROGEN ISOTOPES

We have now to show in what way the differences in permanent energies cause the dissimilarities in the properties of the ordinary and the heavy hydrogen.

The curves in Fig 3 show the permanent energies of both the ordinary and the heavy hydrogen halides Since the bond strength of the hydrogen halide molecules decreases in the sequence → Cl → Br → I, we might expect—remembering that the permanent energy is greater the tighter the bond which holds the atoms in position—that the permanent energy will decrease in the sequence of falling bond strength. This is well borne out by both curves, which show consistently a decrease in the sequence HF → HCl → HBr → HI, and likewise in the corresponding sequence DF → DCl → DBr → DI

The reduction of permanent energy which has been deduced from the uncertainty principle for the case of H being replaced by D is also clearly shown The D-curve lies everywhere below the H-curve The relative depression of the permanent energy is very nearly equal for all four compounds Consequently, the absolute value of the difference in permanent energies is the greater the higher the permanent energy of the original compound This relation when connected with the above-mentioned rule governing the sequence of the permanent energies leads to the important conclusion, illustrated by the lower part of Fig. 3, that the differences in the permanent energies of corresponding H and D compounds fall off in the sequence of decreasing bond strength. Or, putting it in a more general way the contrast between two corresponding ordinary and heavy hydrogen compounds will differ from compound to compound and will be the more marked the firmer the bond by which the hydrogen is linked in the compound

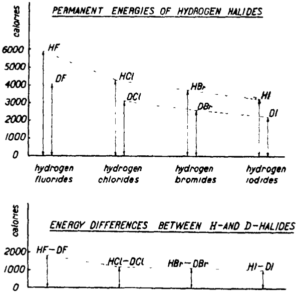


FIG 3

The energies in Fig. 3 are not measured data, but values calculated from molecular theory. A little further discussion leads us to a very sensitive method of checking these theoretical results The diagram shows us that if we replace H by D in hydrogen fluoride, the energy will fall by about 1,600 cal, that is, this amount of energy will be gained Similarly, if we replace H by D in hydrogen iodide, we gain about 900 cal We can express this in the following chemical equations

$$D + HF = DF + H + 1{,}600 \text{ cal} \qquad (1)$$

$$D + HI = DI + H + 900 \text{ cal} \qquad (2)$$

By subtracting equation (2) from equation (1) we obtain, after a slight rearrangement

$$HF + DI = HI + DF + 700 \text{ cal}$$

Hence an interchange of H and D between HF and DI is a reaction in which energy is set free Since reactions always tend to go in the direction in which they produce energy, we might expect that in a mixture of hydrogen fluoride and hydrogen iodide which have between them a certain amount of heavy hydrogen, the heavy hydrogen will have the tendency to unite with fluorine rather than with iodine

An experiment to test this conclusion could be carried out in the following way A quantity of heavy hydrogen could be prepared by decomposing heavy water, for example, by electrolysis We might use one gram of water, containing 1 per cent of pure heavy water, and by completely decomposing it, produce about one litre of hydrogen containing 1 per cent heavy hydrogen From one half of this we could make, with fluorine, one litre of hydrogen fluoride containing 1 per cent of DF The other half would go to form 1 litre of hydrogen iodide containing 1 per cent DI We could now let the two gases mix together in a two litre vessel, and add a trace of water to catalyse the interchange of hydrogen atoms between the two gases On separating the gases and estimating how much heavy hydrogen is contained in each of them, we should find that heavy hydrogen accumulates in the hydrogen fluoride, which will contain about 1 3 per cent of D as against 0 7 per cent of D in the hydrogen iodide.

By carrying out the experiment at a low temperature, for example, – 150° (supposing that an efficient catalyst could be found), the distribution of D would become even more unequal, namely, 1 8 per cent D in hydrogen fluoride as against 0·2 per cent D in the hydrogen iodide

INTERCHANGE REACTIONS OF HYDROGEN ATOMS

Such interchanges of H and D between two hydrogen compounds have been the object of numerous studies, especially at the Universities of Manchester and Cambridge, in Manchester the work was mainly done by Dr J Horiuti, the work in Cambridge is due to Dr A Farkas, Dr L Farkas and Prof E K Rideal Indeed, the principal part played by heavy hydrogen in chemistry is in some way or another connected with such interchange processes

Suppose that we bring together the two gases, hydrogen and hydrogen iodide, and add to these the three liquids, water, benzene and ethyl alcohol, and suppose also that we have appropriate catalysts present to bring about the interchange of the hydrogen atoms between all these compounds, then, after separating the substances, we shall find that each contains a certain part of the heavy hydrogen present in the mixture This characteristic quota of each compound will specify the relative preference which it gives to D over H

Distribution of D between different hydrogen compounds

Hydrogen compound*	Specific quota	Reference
HI	0 17	Calculated from known equilibria
H_2	0 33	A Farkas and L Farkas (*Trans. Far Soc*, **30**, 1071, 1934)
H_2O	1 00	(Arbitrary unit)
C_6H_6	0 95	J Horiuti and M Polanyi (NATURE, **134**, 377, 1934)
C_2H_5OH (hydroxyl group only)	1 5	C E H. Bawn (unpublished)

* The symbol H used here includes both kinds of hydrogen

A list of these quota figures for the five compounds mentioned above is given in the accompanying table, in which the units are, of course, arbitrary From what has been said above, we know that these figures depend on the differences of permanent energy between the ordinary and the heavy compounds We obtain from these figures a rather intimate knowledge about the permanent energy of different compounds which otherwise would not be easily accessible to measurement

The capacity of some substances to accumulate a comparatively high quota of the heavy hydrogen present in a mixture can be utilised in the following way. Suppose we bring hydrogen iodide containing some D into contact with alcohol, then we shall find on separating the two substances a concentration of heavy hydrogen about ten times greater in the alcohol than in the hydrogen iodide If we carry out the process at low temperatures, for example, at − 80° C, the ratio of the two concentrations will be as high as 30 to 1

Processes of this kind may promise to be of use for the manufacture of heavy hydrogen Ordinary hydrogen contains, as I have said, about 1/4,000 of heavy hydrogen To concentrate it from this dilution at a reasonable cost is as yet an unsolved problem

Suppose we convert the hydrogen gained by decomposing ordinary water into hydrogen iodide, and then pass this hydrogen iodide through alcohol at − 80° C, we should get an alcohol containing almost 1 per cent of heavy hydrogen in its hydroxylic hydrogen By decomposing the hydroxyl group of the alcohol, for example, by metallic sodium, a hydrogen containing almost 1 per cent of heavy hydrogen would be set free, and it would be easy to arrive at highly concentrated heavy hydrogen by repeating the process once or twice In practice, this process would probably fail on account of the unavoidable losses of iodine and of alcohol, which would make it fairly expensive

Similar processes based on the unequal distribution of heavy hydrogen between different substances will probably be found practicable sooner or later, and might then bring down the price of heavy hydrogen to the point where it could be used in the manufacture of the more valuable chemical products, such as drugs and dyestuffs.

Another interest attached to the interchange of hydrogen atoms between different hydrogen compounds lies in the possibility which they offer for the preparation of the more complicated compounds of heavy hydrogen It is, of course, not impossible to build up all sorts of heavy hydrogen compounds by synthesising them from their elements, using heavy hydrogen instead of ordinary hydrogen But this procedure might prove rather awkward with many very common substances usually not prepared by synthetic processes, such as benzene, naphthalene, anthracene However, it seems easy to prepare the heavy hydrogen compounds corresponding to benzene, naphthalene, etc, by taking the ordinary substances and replacing in them the H atoms by D atoms.

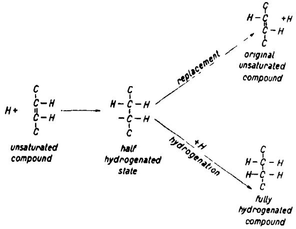
Suppose we want to make benzene with the hydrogen atoms substituted by heavy hydrogen atoms, that is, C_6D_6. A synthesis could be carried out by polymerising synthetic heavy acetylene It seems much simpler to bring the benzene into contact with pure heavy water, adding an appropriate catalyst to let the two substances exchange their hydrogen atoms. If we take 10 gm of heavy water and 1 gm of benzene, about 90 per cent of the hydrogen in the benzene should be replaced in one process A repetition of this procedure should give us benzene containing 99 per cent D in its hydrogen This process is now being tested in Manchester.

The interchange of hydrogen atoms of different compounds has also an interest as a new type of chemical reaction, often related in an interesting way to other 'true' chemical reactions Consider, for example, the replacement of ordinary by heavy hydrogen in benzene The quickest way to obtain this replacement is by bringing heavy hydrogen into contact with benzene at room temperature in the presence of a nickel or a platinum catalyst These catalysts are well known for their capacity to cause the addition of hydrogen to unsaturated compounds, in their presence, ethylene, for example, will react very rapidly with hydrogen to form ethane Benzene likewise adds on hydrogen, forming hydro-benzene, but much more slowly. The replacement reaction will, therefore, be accompanied by a hydrogenation of benzene But experience has shown that the hydrogenation is very much slower than the replacement Only one in a hundred molecules, reacting in the sense of replacement, reacts also in the sense of hydrogenation.

The replacement of ordinary by heavy hydrogen in benzene can also be carried out by bringing heavy water into contact with benzene. This reaction proceeds also in the presence of platinum and nickel catalysts, but it goes much slower than the interchange between ordinary hydrogen and benzene Higher temperatures and longer times are required when heavy water is used for replacement; there is, of course, no hydrogenation whatever

We note that both the hydrogenation and the replacement of hydrogen atoms represent a transfer of hydrogen atoms to the benzene The two processes differ only in the result obtained by the transfer of the hydrogen atom, while in the case of *hydrogenation* the transfer results in the formation of hydrogenated products, like ethane from ethylene, or hydrobenzene from benzene, *replacement* proceeds without any accompanying chemical change.

These alternative reactions can be shown by the following reaction scheme



A hydrogen atom meeting an unsaturated molecule first forms a half-hydrogenated product This substance then, if left to itself, decomposes by dropping one of its redundant hydrogen atoms (see upper arrow), whereby there is at least an even chance that the hydrogen atom lost is not the same one as had been added, and that, in consequence, the result is the replacement of a hydrogen atom This decomposition of the half-hydrogenated state can, however, be forestalled if a second hydrogen atom comes up before it is accomplished (see lower arrow), and links up to the half-hydrogenated molecule, forming a fully hydrogenated compound

If this explanation is correct, hydrogenation will be rare when the interval between the approach of the first and second hydrogen atom is long. In such cases, the reaction will result almost exclusively in replacement of hydrogen atoms, unaccompanied by hydrogenation.

This conclusion is well borne out by our experiments, which show that while a more energetic action of hydrogen on benzene (when gaseous hydrogen is brought into contact with it) causes a replacement of hydrogen atoms, which is accompanied by a quite appreciable amount of hydrogenation, no hydrogenation is found when the action of hydrogen is slow, as, for example, when water is the source of the hydrogen atoms reacting with benzene. Thus the replacement reaction discovered by the use of heavy hydrogen discloses the nature of hydrogenation, which appears now to be a side reaction of the replacement reaction. Similar success may be expected in many other cases.

Low Reactivity of Heavy Hydrogen Compounds

The study of the hydrogen interchanges, to which we originally turned in order to derive information on the energy differences between the ordinary and the heavy hydrogen compounds, has led us away from our starting point We return now to the question raised at the beginning of this lecture—the lower reactivity of heavy water as compared with ordinary water

It is as yet uncertain to what extent the lower reactivity of heavy hydrogen compounds can be considered to be a general rule But it is certainly a fairly widespread condition The possible interest of such lower reactivity is, of course, manifold Hydrogen compounds which ordinarily are readily oxidised or otherwise decomposed might become stable if the ordinary hydrogen is replaced by heavy hydrogen Reactions might be led into new paths or else their output might change considerably Theory and practice would profit abundantly by such phenomena

This lower reactivity of heavy hydrogen and of the compounds of heavy hydrogen can be explained by the theory of permanent energy with which I have already dealt Indeed, it was predicted from this theory when there was still scarcely any experimental evidence for it

The essential connexion between permanent energy and reactivity is easily recognised A molecule undergoes chemical reaction only if it happens to accumulate a certain critical amount of energy The molecule has to wait until, in the course of the constant fluctuation of energy caused by heat motion, it happens to get an especially big share of energy equal to this critical energy As soon as it has swallowed this, it goes to pieces —that is, chemical reaction

Now suppose we have two molecules, one a compound of ordinary hydrogen, the other, the corresponding compound of heavy hydrogen Let both molecules wait side by side until, by a fortunate fluctuation of thermal motion, they acquire the critical energy necessary for reaction The ordinary hydrogen molecule is obviously in a better position in this competition, since it has a start on account of its greater permanent energy. The energy required by it is correspondingly smaller, and it will have an earlier chance to get this smaller quantity It will, therefore, react before its competitor, the heavy hydrogen compound This is the reason for the lower reactivity of heavy water, and of other heavy hydrogen compounds

WATER WITH HEAVY OXYGEN

I have mentioned before that ordinary oxygen of atomic weight 16 is accompanied by small quantities of a heavier isotope of weight 18 This heavy oxygen forms with hydrogen a heavy water of a kind quite different from 'ordinary' heavy water H_2O^{18} in pure form would have about the same density as D_2O, that is, 10 per cent above that of ordinary water The two sorts of heaviness could be combined in 'super-heavy' water, D_2O^{18}, which would have a density of 1 2

It is, however, much more difficult to prepare pure heavy oxygen than it is to prepare pure heavy hydrogen Although the abundance of heavy oxygen in ordinary water is eight times higher than that of heavy hydrogen, it has not yet been isolated The difficulty is that the two sorts of oxygens are chemically identical, and hence we have no convenient hold whereby to grasp the one, leaving the other behind The separation can be carried out only by physical methods which are comparatively ineffective

The best physical method for the separation of isotopes is at present the 'fractionated diffusion' of G Hertz By this method, Prof Hertz has succeeded in preparing about 300 mgm of water containing about 1 mgm of heavy oxygen Prof Hertz gave us this sample and Dr Szabo and the author have made the following use of it

To the water we added a small quantity of metallic sodium, thus forming an alkaline solution Then a few milligrams of amyl acetate were treated with this solution until completely saponified From the amyl alcohol produced by the saponification, the hydroxyl group was split off in the form of water We examined this water, and found that *its density was normal*

It follows that this oxygen does not come from the water used for saponification . it must, therefore, come from the oxygen of the ester-bridge. Or, in chemical symbols

$$\mathrm{AmO\ Ac} + H_2O^{18} = \mathrm{AmOH} + \mathrm{HO^{18}Ac}$$

and *not*

$$\mathrm{Am\ OAc} + H_2O^{18} = \mathrm{AmO^{18}H} + \mathrm{HOAc}$$

This decides a question that had remained open since it was first raised by Van t'Hoff in 1899 Although the answer may only confirm what many chemists had surmised before, still it shows how useful heavy oxygen might become for the elucidation of the mechanism of oxygen reactions such as hydrolysis, oxidation, etc

HEAVY ISOTOPES OF OTHER IMPORTANT ELEMENTS

We have seen that the differences in the chemical properties of ordinary and heavy hydrogen are interesting, both in themselves and as a means of preparing pure heavy hydrogen But often the heaviness of the new hydrogen is used merely as a convenient 'label' to mark the path which the hydrogen follows, when it becomes mixed and interchanged with other hydrogen atoms For this labelling purpose, the heaviness of heavy oxygen, O^{18}, has turned out to be just as useful a tool where reactions of oxygen are concerned The same is obviously true for N^{15} and C^{13}, with respect to the study of reactions involving nitrogen and carbon*

Heavy hydrogen has a start over the other isotopes of the more important elements, because it was the first to be isolated in quantity When we have the other isotopes at hand in sufficient quantities, they may well prove even more important than heavy hydrogen All branches of chemistry will benefit by such progress, but it is likely that the greatest stimulus of all will be given to the chemistry of living matter when such labelled carbon, hydrogen, oxygen and nitrogen atoms will become generally available

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* Labelling of atoms by isotopes was first introduced by Hevesy and Paneth in their method of 'radioactive indicators' (See, for example, Hevesy and Paneth, "Lehrbuch der Radioaktivität" J A Barth, Leipzig (1923), p 105)

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Forestry in British Honduras

THE chief note of the annual report of the Forest Trust of British Honduras for the biennial period ending March 31, 1933 (Govt. Printer, 1934) is one of marking time. The Department has now had ten years experience, but the increasing depression in the trade of the Colony necessitated economy during the period under review and the personnel was reduced to a skeleton service. The Forest Trust had early decided that further sylvicultural work, with its long lock-up of capital, was to be discontinued, and all reserves were placed on a 'care and maintenance' basis, an expression which will convey little to the forester possessing an acquaintance with the tropical forest. The energies of the Department are to be applied, therefore, to the furtherance of research work into the exploitation and marketing of the secondary timbers, with the view of taking prompt advantage of the recovery of world trade, when the present depression lifts. So far as it goes, this may be regarded as satisfactory, but the Department will have a long row to hoe before the position of half a decade or so ago is re-attained. The following extract from the report in connexion with *taungya* is of importance and should interest West African forest officers: "The practice of seeding-up the annual corn-plantation with mahogany continues to give excellent results. Mahogany seed is dibbled in lines with the maize at 10 by 10 feet intervals, and the area is abandoned after the first crop has been harvested. The mahogany is then sufficiently established to compete with the weed growth, which very quickly closes the canopy. Over-topping of the mahogany by weed-growth is found to be beneficial in preventing shoot-borer (*Hypsiphylla grandella*) attack. Tending consists of removing vines. It is becoming very apparent that huamil (secondary growth) conditions are very favourable to the growth of mahogany, which grows well whilst its head is just under huamil canopy, and that heavy cleaning is not only undesirable but often disadvantageous in rendering the mahogany susceptible to the shoot-borer attack."

Preservation of Newspaper Records

NEWSPAPERS are an important class of historical records as they give a clear view of contemporary life and events. The newspaper files preserved in libraries give valuable reference records for historical purposes. Unfortunately, the paper on which they are printed is often made of crude ground wood fibre, which rapidly perishes, and the space they take up in libraries is excessive. In publication No. 145 of the U.S. Bureau of Standards (Washington: 5 cents), B. W. Scribner describes researches that have been made on methods of preserving newspapers. For retarding decay, the use of Japanese tissue paper has been found effective. Transparent cellulose acetate sheeting is also useful. Pending the development of more satisfactory materials and methods, an effort should be made to copy the most valuable of the older newspaper records on permanent paper by photostatic printing or photolithography. Reproduction in miniature is the ideal method of reducing the space required. The technique of making miniature prints of newspaper records on transparent slides and projecting them in enlarged form for reading is making satisfactory progress. The life of the types of flexible film so far used is only about thirty to forty years. It is recommended that a joint effort be made at once by scientific and library organisations to find the most practical means for preserving newspaper records. Special stress should be laid on perfecting materials and methods of reproduction in miniature. The advisability of founding a central agency for supplying reproductions of newspapers and other records to libraries should also be considered.

Rubber and Agriculture

THE rapid development of the rubber industry has been one of the most notable industrial events of the present century. Between 1910 and 1933, the net amount of crude rubber exported from the principal producing countries increased from 94,000 tons to 851,000 tons per annum, while the world absorption of the manufactured product rose from 85,000 tons to 814,000 tons during the same period. Although the demand for motor tyres has been primarily responsible for this expansion, rubber has now found its place in practically every branch of industry. To illustrate the various ways in which it may be used on the farm, the Rubber Growers' Association (2-4 Idol Lane, Eastcheap, E.C.3) has issued a booklet entitled "Rubber and Agriculture". In outdoor equipment, not only can tyres of every description be supplied to suit everything from a tractor to a wheelbarrow, but also jointed tracks are successfully made. The inconvenience of the ordinary tipping device for unloading lorries is now avoidable by using a vehicle fitted with a rubber movable floor, which discharges on either side as desired. In the cow shed and dairy, rubber stalls and flooring, rubber parts to the milking machines and rubber rims to the churns to reduce noise, are some of the uses to which this product can be put. In the farmhouse itself rubber is becoming increasingly popular; rubber floor coverings, brushes and oven rubber upholstery now being practical propositions, while for the farmer and his family, rubber clothing of various types is a recognised part of their outfit.

Small Sparks due to Static Electricity

THE small sparks due to static electricity, similar to those sometimes observed when combing the hair or walking over a thick carpet, have caused fires which cost industry an appreciable amount, both in life and property. According to Science Service, of Washington, D.C., a study made by the Fire Protection Association shows that during the last six years 147 fires in the United States have been attributed to this cause. A frequent cause of sparking is the friction of an endless belt running over pulleys. In an atmosphere containing a certain amount of inflammable gases, this would be sufficient to cause an explosion which might result in a serious fire.

Static sparks have also been observed when 'dry' liquids like petrol or ether are being handled. When any inflammable liquid is being poured from one vessel into another it should always be discharged so that there is no appreciable fall through the air into the lower vessel It is well known that the human body can store electricity sufficient to cause a small spark when it is brought near an earthed conductor Coal gas can be ignited in this way Cases have been recorded where static discharges from a painter's hand have ignited the vapour from a paint remover In another case, vapours from rubber cement were ignited by a spark from the body of a woman who was working near it

Cæsalpinus and Harvey

In a letter to the *Lancet* of November 17, dealing with the remarkable absence of any reference in Harvey's writings to his predecessor Cæsalpinus, who is still regarded by some Italians as the discoverer of the circulation of the blood, Dr D F Fraser-Harris remarks that he has recently found the three words "J Cæsalpinus Aretinus" in a translation of the MS notes of Harvey's lectures edited by a committee of the Royal College of Physicians in 1886 He points out, however, that the Christian name of Cæsalpinus of Arezzo was Andreas, so that the initial letter should have been A instead of J He therefore suggests that Harvey, whose handwriting was execrable, really wrote "J Cæs. Arantius", an abbreviation of Julius Cæsar Arantius, the celebrated anatomist of Bologna (1530–89), to whom Harvey afterwards referred in his essay on the placenta when dealing with the relation of the umbilical vein to the uterine vessels In support of this suggestion is the context, in which Harvey is describing the three semi-lunar valves at the base of the aorta and pulmonary artery, on the cusps of which the corpora Arantii are found.

Ramanujan Memorial Prize in Mathematics

In 1933 the University of Madras offered a Ramanujan Memorial Prize for the best thesis based on original contributions submitted by an Indian (or one domiciled in India) on some definite branch of mathematics, applied or pure The underlying idea was to stimulate interest among the younger mathematicians of India and to attempt in some way to commemorate the spirit of the late S Ramanujan, the first Indian fellow of the Royal Society, whose untimely death in 1920 at the early age of thirty-two years robbed the world of one of the most brilliant mathematicians of his time A number of theses were submitted and the University of Madras has now announced that the prize of value about £70 (nine hundred rupees) has been divided equally between the following S. Chandrasekhar, fellow of Trinity College, Cambridge; S. Chowla, reader in mathematics, Andhra University, Waltair, India; D. D. Kosambi, professor of mathematics, Ferguson College, Poona, India. Ramanujan was the first Indian to be elected to a fellowship at Trinity College, Cambridge, and it is interesting that two of the successful candidates (S Chandrasekhar and S Chowla) are both Trinity men

Air-Conditioning in Mines

We are informed that air-conditioning plant is about to be installed in the well-known Robinson Deep Mine, Johannesburg, South Africa, the deepest point in the mine being 8,380 ft below the surface of the earth The mine is naturally hot and damp, the high temperature (100°-120° F) being due to adiabatic compression at the lower levels, it is calculated that the temperature increases 5° for an average depth of every 1,000 ft of the mine The air is also very moist, having a relative humidity of 90-100 per cent, owing of course to the necessity of wetting the mine walls after every blast to prevent siliceous dust from being thrown into the air and being inhaled by the workers, thus causing the silicosis which is well known to be the scourge of South African mining It is stated that the air-conditioning, cooling and dehumidifying plant is the largest in the world, and will be capable of dealing with 400,000 c ft. of air per minute It is stated that the cooling effect is equal to 4,000,000 pounds of ice

Research on Silicates

In *Veroffentlichungen aus dem Kaiser Wilhelm-Institut fur Silikatforschung in Berlin-Dahlem* are reprinted a large number of papers published since the beginning of 1932 There are two papers on chemical and thermodynamic aspects of the constitution of glass, two on cements, and one on the specific heats of calcium-aluminium silicates with special reference to the Neumann-Kopp rule Many of the papers are incomplete in the sense that they are part of a series and must be judged as such One paper of particular interest deals with the reactions of glass-forming oxides under high pressures of oxygen, up to 350 atmospheres The authors, H Möttig and W Weyl, consider that in glasses containing lead, plumbates are formed, in glasses containing barium they have evidence of the presence of the peroxide. High oxygen pressure modifies the colouring effect of a given amount of manganese additive

Greenland Researches

The Oxford University Exploration Club has published in one volume the collected reports from various journals on the work of the Club's expedition to Greenland in 1928 ("Greenland and Spitsbergen Papers" Oxford University Press, 1934). This expedition, under the leadership of Dr. T G Longstaff, aimed at an intensive study of the ecology of a small area in Godthaabs Fjord, and its results have been published in some ten British and foreign journals. These nineteen reprints are now conveniently bound together and include important papers on the vegetation, birds and insects. In addition, the volume embraces four papers, principally geological, on Spitsbergen, the outcome of the Oxford Expeditions to Spitsbergen in 1921, 1923 and 1924. These are supplementary to the collected papers of those expeditions which appeared previously in the two volumes of "Spitsbergen Papers" The volume shows the extent of valuable work that can be done by a small summer expedition to polar regions, especially when the sphere of work is well defined

Map of Central America and West Indies

A USEFUL map, embodying the latest information, of Mexico, Central America and the West Indies on a scale of 90 miles to an inch is published by the National Geographic Society at Washington It is in the main a political map and relief is shown only by hachures, but a number of spot heights are given Railways and the main highways are shown, and there are many names Insets show the more important West Indian islands on larger scale The colour printing is very clear

Eradication of Prickly Pear in Queensland

THE reclamation in Queensland of land formerly infested with prickly pear (*Opuntia* spp) steadily continues During the year which ended on June 30 1934, 5,300,000 acres were made available for selection or for lease under developmental tenure The total area reclaimed and thrown open for settlement during the past three years is 13,750,000 acres, or approximately 20 per cent of the whole infested region

International Congress of Americanists

THE twenty sixth session of the International Congress of Americanists, which was to have taken place during November in Seville, had to be postponed owing to financial and political difficulties in Spain The work of organisation is, however, well advanced and it is hoped that it may still be possible to hold the Congress early in 1935 It is unfortunate that the deliberations of this body, which are invariably of great scientific interest to students of the cultures of aboriginal America, should be subjected to interruption through political unrest It will be remembered that when the Congress last met in La Plata at the close of 1932, conditions were anything but favourable to an international scientific assembly, and, indeed, had it not been for a certain disorganisation arising out of these conditions, it is probable that the invitation of Great Britain would have been accepted and the Congress would have met in London in close association with the First International Congress of Ethnological Sciences in August last

Imperial Botanical Conference

AN Imperial Botanical Conference, commencing on August 28 and lasting two to three days, according to the programme which may finally be arranged, will be held in London this year. The subjects set down for discussion are of general interest to Empire botanists, and include such topics as pasture research within the Empire, the ecology of tropical forests, the application of ecological methods to the study of native agriculture, problems of fruit storage and transport with special reference to tropical conditions, the furtherance of schemes for the closer co-ordination of botanical research within the Empire, etc It is hoped that this Conference will furnish a convenient meeting ground for home and overseas botanists who are on their way to attend the International Botanical Congress which meets at Amsterdam in the week following The chairman of the Organising Committee of the Conference is Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, and the honorary secretary is Prof W Brown, Imperial College of Science and Technology, South Kensington, London, S W 7, from whom further particulars may be obtained

Announcements

MR FRANCIS N RATCLIFFE, assistant in the Natural History Department, University of Aberdeen, has been appointed to the head-quarters staff of the Council of Scientific and Industrial Research, Commonwealth of Australia

THE first volume of the new international botanical yearbook to be known as *Chronica Botanica*, to which reference was made in NATURE of September 29, p 493, will be published shortly Heads of botanical institutions, etc , who have received the questionnaire are therefore requested to return it to the publisher, Fr Verdoorn, P O Box 8, Leyden, Holland, as soon as possible Answers should reach Leyden before January 10 from Europe, January 20 from the United States and Canada, and January 30 from other parts of the world

A RECENTLY issued catalogue of books and periodicals on natural history for sale by Bernard Quaritch, Ltd , covers zoology, geology and palæontology, and contains a good selection comprising more than 2,000 items

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in science and hygiene in the Liverpool City Technical School for Women and F L Calder College of Domestic Science—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (Jan 7) An assistant lecturer in pharmacy in the Technical College, Bradford—The Director of Education, Town Hall, Bradford (Jan 15) Three chemists at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S W 7 (Jan 18) Assistant lecturers in metallurgy in the University of Birmingham—The Secretary (Jan 21) Two research bacteriologists in the Medical Research Department of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, W C 2 (Jan 26) A bacteriological research assistant to the Metropolitan Water Board - The Clerk, 173, Rosebery Avenue, E.C 1 (Jan 26) A research assistant in tissue culture and assistant lecturer in histology at the University of Birmingham —The Secretary (Feb. 1) A lecturer in chemistry at University College, University of Rangoon—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, London, W.C 1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 37.

Passage of Helium through apparently Compact Solids

IT has been known for some time that helium can pass at the ordinary temperature through silica glass, and also, to a less extent, through pyrex glass. Common glasses, however, are not known to be sensibly permeable.

It was thought of interest to search for other solid materials which might have the property of passing helium far more readily than air.

I have found, in fact, that sheet gelatine, celluloid and cellophane, all behave somewhat like silica glass.

Silica glass and celluloid, when carefully examined in the polariscope, are found to be of the nature of crystalline mosaics, and it is likely that the helium finds its way between the crystals. The same probably applies to gelatine.

There is, however, an interesting field of work in examining whether helium can pass through various crystal lattices (single crystals). A few preliminary experiments have been made. I have confirmed the known result that helium cannot pass through crystalline quartz, and have found further that it cannot get through mica. The case of beryl is of special interest. According to the analysis of W. L. Bragg and J. West[1] the structure of this crystal is exceptionally open, having unobstructed tunnels parallel to the optic axis, each tunnel being about the same diameter as an oxygen atom in the crystal. It seemed worthy of investigation whether helium would go through. I had a slice cut 0.6 mm thick perpendicular to the axis of a clear and apparently flawless aquamarine. This did in fact transmit helium as indicated in the table below. It is not yet certain whether the helium really passed through the lattice, or merely through flaws or cracks in it. No flaws could be seen, however. The test of whether air would pass through has been applied, but for technical reasons it is more difficult to be sure about the non-passage of air than about the passage of helium. In any case, helium would be expected to pass through more quickly, even if the transmission were through flaws. More severe tests are in progress. It will be important to determine the behaviour of a slice cut parallel to the axis.

Material	Transmission in c mm per day Helium	 Air	Ratio Helium/Air
Fused silica	4×10^{-1}	—	—
Gelatine	9.23×10^{-1}	5.02×10^{-3}	185
Celluloid	39.5	1.94	20
Cellophane	1.36×10^{-1}	3.23×10^{-3}	42
Quartz cut ⊥ to axis	$< 1.01 \times 10^{-4}$	—	—
Mica	$< 2.5 \times 10^{-4}$	—	—
Beryl cut ⊥ to axis	1.34×10^{-1}	$< 2.0 \times 10^{-2}$	> 7

The accompanying table gives the main results so far. The transmission has been taken provisionally to be inversely proportional to the thickness, and the results are reduced to 1 mm thickness and 1 sq. cm area. The gas passes from atmospheric pressure on one side to vacuum on the other.

It should be mentioned that the actual figures for the organic materials are provisional, there being some evidence that the rate falls off with time. This may be the effect of continued mechanical stress due to the gas pressures.

RAYLEIGH

Terling Place,
Chelmsford.
Dec. 17.

[1] *Proc. Roy. Soc.*, A, 111, 691; 1926.

Penetration of a Magnetic Field into Supra-Conductive Alloys

USING the same method as in our work on tin[1], we have investigated the behaviour of supra-conductive alloys in a magnetic field. We studied a carefully prepared sample of Bi_5Tl_3 and a lead-thallium alloy containing approximately 65 per cent thallium.

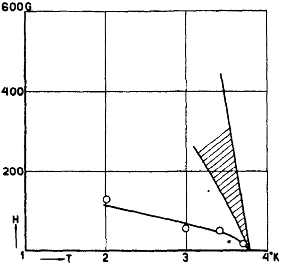

FIG. 1

A cylindrical rod with a channel along its axis was made of each material, and a thin bismuth wire with current and potential wires was fitted inside this channel; we measured the change of resistance of the bismuth wire as a function of a transverse magnetic field (that is, of a field perpendicular to the axis of the cylinder). At a temperature below the transition point of the alloys, the bismuth wires did not show any change of resistance when a weak magnetic field was applied. When the strength of the field exceeded a certain critical value, a change of resistance was produced, though the alloy itself remained supra-conductive.

The value of the critical field is different for the two alloys and depends on the temperature. Fig. 1 shows the value of the critical field as a function of the temperature; in the shaded region the resistance of the alloy is gradually coming back In the case of Bi$_5$Tl$_3$ the result was analogous.

When the field was switched off, the resistances of the bismuth wires did not return to their normal value[2]; we have not yet determined exactly the maximum value of the magnetic field which may remain in the alloy, but it seems to be of the order of magnitude of the critical field We are inclined to believe that the critical value of the field, that is, the value at which the field starts to penetrate into the alloy, as distinguished from the threshold field at which the resistance is coming back, may come into play in several phenomena, for example, in experiments on thermal conductivity[3]

A detailed account of the influence of a magnetic field on alloys will shortly appear in *Physica*

W J DE HAAS
J M CASIMIR JONKER

Kamerlingh Onnes Laboratory,
Leyden
Dec 7

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[1] W J de Haas and J M Casimir-Jonker, *Physica*, 1, 291, 1934

[2] cf T C Keeley, K. Mendelssohn, J R Moore, NATURE, **134**, 773, Nov 17, 1934

[3] W J de Haas and H Bremmer, *Leiden Comm*, 220 c

Further Experiments with the Magnetic Cooling Method

CONTINUING our experiments[1] with the magnetic method, we investigated the suitability of a number of substances The efficiency of a substance for this purpose can be defined by a characteristic temperature θ_m, which may be calculated by means of a formula which we derived under certain simplifying assumptions about the splitting of the ground state of the magnetic ions According to this formula, the final temperature reached in demagnetising to the field zero is inversely proportional to the initial magnetic field, proportional to the initial temperature and to the temperature θ_m, characteristic for each substance, defined by $\theta_m = U/k$ (U = energy difference between the adjacent levels of the ground state, k = Boltzmann's constant) Thus, the smaller θ_m, the more suitable is the substance for attaining low temperatures.

We found that the numerical values of θ_m for the substances investigated lay between about 0 2° and 0 06° Gadolinium sulphate[2] has the highest value; next, approximately equal, come manganese ammonium sulphate and chromium potassium alum (the substance chiefly used in the Leyden experiments[3]). Manganese ammonium sulphate, however, shows at very low temperatures deviations from the formula of a kind which suggest the existence of a Curie point slightly below 0 1°[4]. Finally follows iron ammonium alum which proved to be the most suitable of the substances we investigated. With it, for example, a temperature of 0 04° was obtained, starting at 1 25° and 14 kilogauss Preliminary experiments with mixed crystals showed that by diluting the magnetic ions one can reduce the characteristic temperatures.

The technique was further developed, so that there is now no special difficulty in reaching the lowest temperatures, or in keeping even small amounts of substances (some tenths of a gram) at these temperatures for considerable periods. We generally chose a rate of warming up between ½ and 1 millidegree per minute.

Investigations on supra-conductivity in this region were also continued Two further new supraconductors were found, namely, zirconium and hafnium, pure samples of which were very kindly lent to us by Dr J H de Boer of the Philips Company The transition point of zirconium lies at 0 7$_0$°, the initial slope of the magnetic threshold values being about 300 gauss per degree In the case of hafnium we could use only a very small sample (25 c mm.) so that the accuracy of the numerical values is not very high Extrapolation to zero measuring field gives a transition point between 0 3° and 0 4° Copper, gold, germanium, bismuth and magnesium, at least the samples used by us, did not become supra-conducting down to 0 05

In investigating these metals we had still another purpose It is to be expected that the entropy due to the random distribution of the nuclear spins will vanish within the new temperature region, where kT may be of the order of the interaction energy between the nuclear spin and the surrounding particles[5] From their hyperfine structure (separation 10^{-2} cm^{-1} to 1 cm^{-1}) it appears that the corresponding temperature for the free atoms should lie in the region between 0 01° and 1° For compact metals nothing can be accurately predicted, but it is likely that the interaction energies will be smaller than in the gas

By mixing a substance with a paramagnetic salt, one should be able to render observable the entropy due to the change of the distribution of the nuclear spin, since in this case one would not reach such low temperatures as with the pure salt In cooling to 0 05°, using a mixture of equal volumes of metal and salt, one should detect these effects if the separation were greater than about 10^{-2}–10^{-3} cm^{-1} As no difference in the final temperatures which could be definitely attributed to this effect was found, it appears that the separations in the solid are lower than the limit mentioned above In the case of bismuth this means that the separations are reduced, at least by the factor 100, on passing from the gaseous to the metallic state.

N KURTI
F SIMON

Clarendon Laboratory,
Oxford
Dec 15

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[1] N Kürti and F Simon, NATURE, **133** 907, 1934 *Physica*, 1, 1107, 1934 A detailed report will appear shortly

[2] Our results with this substance agree satisfactorily with those of Giauque and MacDougall, *Phys Rev*, **44**, 235, 1933

[3] W J Haas and E C Wiersma, *Physica*, 1, 779, 1934

[4] See Debye, *Sitzungsber*, *Math Phys Kl Sachs Akad Wiss*, **86**, 105, 1934

[5] See, for example, F Simon, *Z Phys*, **81**, 826, 1933

The Vortex Concept

RECENTLY Great Britain has lost two of its chief promoters (W. M Hicks and H Lamb) of vortical hydrodynamics, a science which was in the main line of physical suggestion forty years ago Some historical reflections are thereby suggested.

One would think at first glance that the whole affair is implicit in a few sections at the end of Lagrange's "Mecanique", when he asserts, but without irreproachable proof, that every portion of uniform non-viscous fluid whose motion at any time involves a velocity potential continues to move subject to that restriction. For the Lagrangian principle implies that portions of the fluid mass the motion of which is vortical remain separate from the surrounding non-vortical portions. Rather, that inference ought to have come immediately to Stokes nearly half a century later, for it was he who fortified the Lagrangian analysis and introduced vorticity or local spin as the property negated by a velocity potential But the matter was not so obvious

It was left for Helmholtz to inquire whether there could in fact be persisting motion without a potential, and to explore its laws on the basis of Riemannian continuity The motion must, as he found, be made up of filaments of spin which preserved their material identity, and which if finite must close up as rings Thus a vortex ring could be imagined as made up of adjacent threads like a hank of silk, and the question is whether they could hold together or would reduce themselves to confusion by mutual disturbance This is the question of stability of vortex motion, which gave rise to so much difficult analysis, with only limited results for cases in which facile experiment had led the way There is no limit to the thinness of the filaments, but they must not go down to molecular cross section, so that as in other molecular science the convenient terms macroscopic and microscopic claim their places, and there is no transition from fluid-theory to gas-theory

Thus a vortex ring, even though thoroughly stable, fades gradually owing to the viscidity of the molecular medium It would be interesting and valuable to consider, on the foundation also established by Stokes, whether, for example, a straight vortex cylinder fades from core outwards, and how rapidly perhaps the complex analysis involved has already been worked out The interest is mainly that in actuality a vortex ring is a carrier of momentum, and the distance it is transferred is thus an essential feature, for example, in aeronautic theory

It is needless to recall that the behaviour of vortex rings in fluid was the stimulant and earliest actual illustration of how a molecular medium could exist in and be controlled by an aether in which the molecules subsist as regions of permanent singularity

JOSEPH LARMOR

Holywood, Co Down
Dec 5

The X-Ray Crystal Scale, the Absolute Scale and the Electronic Charge

IN 1928 I published some investigations[1] on the X ray wave length of the aluminium $K\alpha_{1,2}$ line on the absolute scale, as obtained with the plane ruled grating method From this the wave-length in question came out as about 0 15 per cent higher on the absolute scale than that found by the ordinary crystal method This difference was considerably greater than expected from the stated uncertainties of the constants involved in the computation of the crystal lattice of calcite, which constitutes the crystal scale. As is well known, this result therefore was looked upon with decided scepticism

Later measurements on the same subject, of which that of Bearden in 1931[2] claims the highest precision, have secured this result The most simple way of explaining this discrepancy, namely, to ascribe it to the uncertainty in the value of the electronic charge, was systematically avoided On the contrary, the influence of the mosaic structure was suggested to give the explanation of the difference, or simply that the laws of optics were not applicable to X-rays. The first of these reasons seems to have lost its reality after the investigations of Allison[3] and Tu[4], according to which the effect of such supposed irregularities in the crystal structure is of little importance. The only support for the second suggestion seems to be the discrepancy itself which has been mentioned

However, the investigations of Allison and Tu favour the opinion that this method (ruled grating and crystal determinations combined) may even be used for a reliable determination of the electronic charge As the method has often been looked upon with some doubt, perhaps originating from the earlier inconsistent results, it seemed to me that it would be of interest to use the ruled grating method under different conditions Therefore I have carefully analysed the method and its possibilities with regard to the resolving power, the sharpness of the spectral lines, the reproducibility under different conditions, etc

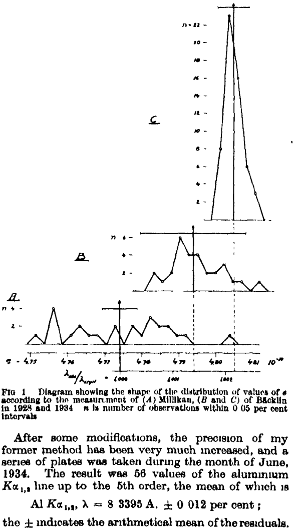

FIG 1 Diagram showing the shape of the distribution of values of *e* according to the measurement of (*A*) Millikan, (*B* and *C*) of Bäcklin in 1928 and 1934 *n* is number of observations within 0 05 per cent intervals

After some modifications, the precision of my former method has been very much increased, and a series of plates was taken during the month of June, 1934. The result was 56 values of the aluminium $K\alpha_{1,2}$ line up to the 5th order, the mean of which is

$$\text{Al } K\alpha_{1,2},\ \lambda = 8\ 3395\ \text{A.} \pm 0\ 012 \text{ per cent};$$

the ± indicates the arithmetical mean of the residuals. As to the reliability of this value, it may be noticed that after liberal estimation of all imaginable errors, their total sum does not reach 0 03 per cent.

The crystal value of this wave-length from Siegbahn's "Spektroskopie der Röntgenstrahlen", 1931, and corrected for diffraction (8·32135) gives the relative increase

$$\frac{\lambda_{\text{abs.}} - \lambda_{\text{cryst}}}{\lambda_{\text{cryst.}}} = 0{\cdot}218 \text{ per cent and } \frac{\lambda_{\text{abs}}}{\lambda_{\text{cryst.}}} = 1{\cdot}00218$$

corresponding to a value of the electronic charge

$$e = 4\cdot 805 \times 10^{-10} \text{ E S U.}$$

instead of that ($e = 4\cdot 774 \times 10^{-10}$) used by fixing the crystal scale This new value is in very good accordance with Bearden's 1931 value.

For comparison with older results I have used a similar diagram (Fig 1) as before[5] showing the error distribution for Millikan's measurements and my own in 1928 and 1934 On account of the very small dispersion of the new values, the interval (within which n is the number of observations) has been diminished from 0·1 per cent to 0·05 per cent

A more detailed description will soon be published elsewhere.

ERIK BACKLIN

Physics Laboratory,
Uppsala
Nov 25

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[1] Erik Bäcklin, Diss, Uppsala Univ Årsskrift
[2] J A Bearden, *Phys Rev*, (2) **37**, 1210, 1931
[3] S K Allison, *Phys Rev*, (2) **44**, 163, 1933
[4] Y Tu, *Phys Rev*, (2) **40**, 662, 1932
[5] loc cit and NATURE, **123**, 409, 1929

Experimental Analysis of Population Growth

HUMAN populations have always proved favourite material for analysis by statisticians and others interested in mathematical theories of population growth. From the experimental aspect, however, humans are far from being ideal biological material, so that other animals, such as protozoa, mammals and insects, have to be used; although it does not yet appear to be fully realised how suitable the latter are for this type of work The theory of biotic potential and environmental resistance[1] has done much to create a new interest in population studies in that it attempts to place the problem upon a quantitative experimental basis Working with *Tribolium confusum*, Chapman demonstrated that, irrespective of the initial density, a point of equilibrium is eventually attained after which the population remains relatively constant, provided the floury medium is renewed frequently enough to remove waste products and maintain an abundance of food He concludes that equilibrium is attained when the biotic potential is equalled by the environmental resistance, and that the lack of population increase is not due to the absence of eggs or their infertility, but on account of the eating of eggs and pupæ by the adult beetles

Later, it was shown by one of us[2] that this explanation of the stationary character of the population is only partially correct, since, in the higher densities, there is a rapid falling off in the number of eggs oviposited and a considerable decrease in their fertility. At the same time, it was demonstrated for *Tribolium confusum* and *Calandra granaria* that there is an optimum density, above and below which reproduction takes place at a reduced rate. In attempting to explain this phenomenon, it was pointed out[3] that important factors were involved in "the frequency and chances of interruption of copulation in the various densities". These factors have now been analysed in detail. Our experiments show conclusively that there is a definite biological law relating frequency of copulation to population density in *Calandra granaria* and *C. oryzæ*, and that there is an 'optimum' density for frequency of copulation in these, and presumably other, insect species The data are presented graphically in Fig 1.

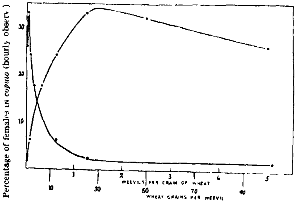

FIG 1

For densities higher than the 'optimum', our experimental data conform very closely to the theoretical relationship represented by the formula

$$\text{Log } Y = \log a + b \log X,$$

where Y is the frequency of copulation and X the number of wheat grains per weevil Further, it is apparent (see accompanying table for data) that the rate of oviposition is highly correlated with the frequency of copulation, and the latter is, therefore, a dominant factor in the rate of population growth when other factors are at or near their optimum for the species The 'optimum' densities for the above processes are not absolute and can be shifted in either direction by altering the physical or biotic factors of the environment, such as the temperature or the sex-ratio

No of Weevils	4	8	16	32	64	128	128	128
No of Wheat Grains	800	400	400	400	400	200	100	25
Weevils per grain	0·005	0·02	0·04	0·08	0·16	0·64	1·28	5·12
Grains per Weevil	200	50	25	12·5	6·25	1·56	0·78	0·19
Copulation Frequency*	22·85	31·97	33·06	24·23	17·68	5·89	2·56	1·60
Eggs per Female per day	6·75	3·52	—	3·02	—	1·60	—	0·59
Species	*Calandra oryzæ*, L Temp 25° C Rel humid 90 per cent Sex-ratio 50 50							

* Average percentage of females *in copulo* per hour

Our studies are being continued and will appear in detail later, but so far as they have gone, some important points emerge (1) In determining certain biotic constants (for example, oviposition rate) it is not sufficient to define the temperature-humidity conditions of the experiment—the density and sex-ratio of the population must also be stated. (2) In the limitation of population growth, the greater the favourability of the physical factors of the environment the less significant do they become, and (assuming absence of parasites and predators) the greater the importance of the rôle of *autobiotic* factors In Nature, these factors will be of greatest moment when the population approaches 'plague' dimensions. (3) It seems, therefore, that natural populations can exert an automatic check on their numerical increase, and that the organism itself imposes the ultimate limit to its own abundance when all other factors normally inhibiting population increase have failed.

STEWART MACLAGAN
EDWARD DUNN

Natural History Department,
University of Aberdeen.

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[1] Chapman, R. N., "The Quantitative Analysis of Environmental Factors", *Ecology*, 9, 111; 1928.

[2] MacLagan, D. S., "The Effect of Population Density upon Rate of Reproduction", *Proc. Roy. Soc.*, B, 111, 437; 1932.

Exhibition of 'Autogenous' Characteristics by a British Strain of *Culex pipiens* L. (Diptera, Culicidæ)

A FEW years ago, Roubaud[1], De Boissezon[2] and Huff[3] independently directed attention to the fact that females of certain strains of *C. pipiens* were remarkable, not only in being able to breed, under suitable conditions, throughout the winter, but also in being able to lay fertile eggs without a preliminary meal of blood. Roubaud considers these unusual characteristics to be indicative of a distinct, 'autogenous' race of *C. pipiens*, which thrives (in his opinion) exclusively in urban areas where artificially-heated buildings are common. De Boissezon, on the other hand, denies the existence of such a race of *C. pipiens*, and asserts that the biological peculiarities in question may be caused to manifest themselves in any strain of *C. pipiens* (whether town- or country-bred) merely by giving the larvæ plenty of rich food and keeping them warm.

During the year 1932, two separate 'autogenous' strains of this species were imported into England—one, in the form of adults, from Hungary, and the other, in the form of larvæ and eggs, from Germany—and were investigated by Miss M. Vincent[4] and Dr. Malcolm MacGregor[5] respectively. From the material thus obtained, both of these experimenters succeeded in rearing a number of generations of *C. pipiens* without providing any of the females with blood-meals. The adults derived from both of the above-mentioned countries were markedly stenogamic, the German ones mating satisfactorily in cages having a volume of only one eighth of a cubic foot, and the Hungarian ones in "small cardboard tubes".

So far as we are aware, no case of autogenous characteristics being exhibited by a British strain of *C. pipiens* has ever been recorded. The following facts may therefore be of interest.

On October 6 we found, on the surface of water in an outdoor tank (in which, it may be noted, a species of *Chara* is growing), a small raft comprising 105 eggs of *C. pipiens*. We transferred this raft into a laboratory tank containing ditch-water, into which crumbs of wholemeal bread were thereafter introduced from time to time. The eggs composing this raft hatched on October 8, and by October 24 most of the larvæ had reached the fourth instar. Owing to the mildness of the weather throughout October, the central heating of the building was not put into action until October 31; the temperature of the laboratory during the previous four weeks having varied between 10° and 18° C.

On November 1, with the view of obtaining some freshly-hatched adults for mounting, we transferred the larvæ and some water from the laboratory tank into a small breeding-jar, which has since then been kept in close proximity to a hot-water radiator. Pupæ first appeared in the jar on November 8, and adults commenced to do so on November 12. Adults were removed from the jar when required for mounting, but in no case was a blood-meal given.

On the evening of November 23 we were surprised to see a small egg-raft on the surface of the water in the jar, and we found a second one on the following morning. The first raft (which consisted of 38 eggs) hatched in the evening of November 26, and the second one (of 40 eggs) hatched during that night.

The portion of the breeding-jar above the water-level (that is, the space in which the adults are confined) has a volume of 600 c.c.—about one-sixth that of the cages employed by MacGregor.

J. F. MARSHALL.
J. STALEY.

British Mosquito Control Institute,
Hayling Island, Hants.
Nov. 29.

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[1] *C.R. Acad. Sci. Fr.*, 188 (10), 735-738; 1929. Also, *Bull. Soc. Path. exot.*, 23 (2), 196-201; 1930.

[2] *Bull. Soc. Path. exot.*, 22 (7), 549-553; 1929. Also *Ann. Parasit. hum. comp.*, 12 (3), 182-192; 1934.

[3] *Biol. Bull.*, 56 (5), 347-350; Woods Hole, Massachusetts, 1929.

[4] *Arb. ung. biol. Forsch. Inst.*, 6, 119-122; Tihany, 1933.

[5] *Trans. Roy. Soc. Trop. Med. and Hyg.*, 26 (3), 307-314; 1932.

Do Whales Descend to Great Depths?

As I have stated elsewhere[1], a difference of opinion exists as to the depth to which whales descend. Diver's paralysis or caisson disease is the usual consequence of descending below about 130 ft. Do whales descend below this depth? For obvious reasons, the answer to this question is of considerable interest from a physiological point of view.

Quite a number of awkward facts might be presented to those who, on theoretical grounds, deny that whales descend below very moderate depths. Perhaps the following will suffice.

1. The whaling ships that used to sail from Dundee and Peterhead each carried a number of five-oared boats and several miles of 2¼-in. or 2¾-in. whale-line; and when the ships reached the ice, 600 fathoms of whale line were coiled into each of the boats. It was, however, only in the deeper parts of the Greenland Sea and Davis Strait that it was necessary to coil so much line into the boats; as may be gathered from what Scoresby says, in shallow situations near Spitsbergen and the west coast of Greenland where the whales were caught at an earlier date, a shorter length of line sufficed.

2. When a harpooned Greenland whale 'sounded', or went vertically down, it took out the whale-line very quickly; the wooden bollard in the boat's bow sometimes smoked and threatened to catch fire. At the same time, the boat's bow was pulled down, and if, as sometimes happened, the line became entangled, the boat was liable to be pulled right down. After an interval the whale reappeared near where it went down and was killed.

3. When harpooned whales 'sound' they take out a limited amount of line only.

(*a*) Large Greenland whales took out from 700 to 800 fathoms; half-grown animals from 400 to 600 fathoms, and calves apparently very much less.

(*b*) A full-grown male Bottlenose took out 700 fathoms; females and young males from 300 to 400 fathoms.

(*c*) Large narwhals took out about 200 fathoms.

Except in the vicinity of certain kinds of ice, Greenland whales when harpooned nearly always sounded or dived towards the bottom. What kind of refuge they expected to find at the bottom is not very apparent. Sometimes they died at the bottom and had to be hauled up, occasionally, according to Scoresby, with broken jaw-bones. A log book, dated 1871, now in the Hull Museum, contains the following entry: "June 25th (Lancaster Sound) · Killed a whale which died at the bottom in 600 fathoms of water". ROBERT W GRAY

8, Hartley Road,
Exmouth
Nov 17

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[1] 'The Diving Powers of Whales', *Naturalist*, December 1932 "Arctic Regions", vol 11, p 173 and p 389

Vision in the Ultra-Violet

WITH regard to the discussion which has been taking place in NATURE recently[1], the following observations may be of interest. In 1929, whilst working at the National Institute for Medical Research, Hampstead, with T C Angus, in the course of which we used, incidentally, a double monochromator, and whilst we were fitting this up, we decided to try on ourselves how far we could see into the ultra-violet We decided that one of us could see the λ3130, and the other could not see shorter than λ3650 in the mercury spectrum Another young physicist could see λ3130 quite easily An elderly man could only see λ3650

I have just repeated these observations I can see λ3130 quite easily, as can an assistant of mine and a youth who works in the clinic Only a single monochromator was used for this purpose, this is a Hilger monochromator for the ultra violet, and as Fabry[2] says, there is always a certain amount of background but this remains constant as the wavelength drum is rotated slightly This later procedure brings the line on to and removes it from the collimator slit Thus the line can be picked out against the background The λ3130 line appears as a dark violet colour much the same as λ3650 Since people varying from fifteen to thirty years of age are able to get the sensation of sight with λ3130, it does not seem to be the prerogative of extreme youth

H J TAYLOR

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Nov. 26.

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[1] NATURE, 134, 416, Sept 15, 1934
[2] NATURE, 134, 736, Nov 10, 1934

Oxidation-Reduction Potentials of Hypoxanthine ⇄ Xanthine and Xanthine ⇄ Uric Acid

IN a recent paper, D. E. Green[1] published values of the potentials of the systems hypoxanthine ⇄ uric acid, xanthine ⇄ uric acid, which I had already determined[2]

Green claims to be the first to have demonstrated the reversibility of the system hypoxanthine ⇄ uric acid. He states this, because my data are based on measurements made on equimolecular mixtures of hypoxanthine and uric acid, and consequently the constancy of the normal potential when the proportions of the constituents of the system are varied is not evident. Green asserts this, in spite of the fact that I have shown that the same state of equilibrium (the same potential) is found, whether hypoxanthine is oxidised, or uric acid is reduced. It seems to me then that the curve presented in my work leaves no doubt as to the reversibility of the system.

Green also states that I did not justify the assignment of the value of the number of equivalents in the formula

$$E_h = E_0 - \frac{RT}{4F} \ln \frac{[Hx]}{[U]}$$

where E_0 is the normal potential, $[Hx]$ the activity of hypoxanthine, and $[U]$ the activity of uric acid It is, however, not at all difficult to see that if the reaction taking place in the galvanic cell is an oxidation of hypoxanthine into uric acid, and that this reaction is reversible (as I have shown it to be), then it follows that the above equation is a necessary consequence of thermodynamics I did not consider it useful to insist on its validity in a preliminary note Moreover, this equation does not at all imply equality of the levels of energy at which the four hydrogens are exchanged, since only the initial state and the final state of the constituents of the reaction are to be taken into consideration

Finally, if I have neglected the dismutation discovered by Bach and Michlin, I have done so because Wieland was not able to confirm their findings I quite agree with Green that the short duration of Wieland's experiments may explain why the dismutation of xanthine to hypoxanthine and uric acid was not observed But I should like to point out that if such a dismutation does exist (in any proportion whatsoever), it would not at all affect my results since the ratio $[Hx]/[U]$ remains equal to 1 when two molecules of xanthine are formed at the expense of one molecule of hypoxanthine and one molecule of uric acid

Thus, no objection could be made as to the value, which I found for the normal potential of the system hypoxanthine ⇄ uric acid It is

$E'_0 =$ 0 410 volt at 38° C and at pH - 7 31

(value calculated from my data), or

$E'_0 = -$ 0 399 volt at 30° C and at pH = 7 31

(value calculated from the temperature coefficient that I have later established)

This value is identical with the theoretical one given by Green, namely, − 0 400

As for the system xanthine ⇄ uric acid, the dismutation does bring about a correction for the value of E'_0 but it is inferior to the experimental errors if Bach and Michlin's figures are used. If, however, we apply the method of calculation that Michaelis has shown in his well-known work on two-step oxidations, and making use of Green's figures, we arrive at a new value for the dismutation constant This value should be taken into consideration, although the resulting variation, when applied to equimolecular mixtures, is rather small.

Applying this correction, the value of the normal potential of the system xanthine ⇄ uric acid will then differ from the one that I have indicated by − 0 0048 volt at pH = 7 65.

D E. Green's confirmation of the existence of a dismutation process is therefore of interest. It entails a correction of the same order as the one brought about by the ionic concentration effect, which I have studied in detail in a memoir actually in press.

SABINA FILITTI.

Institut de Biologie physico chimique,
Paris.

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[1] *Biochem. J*, 28, No 4, 1550; 1934
[2] *Compt. rend. Acad. Sci.*, 197, 1212; 1933. 198, 930; 1934.

Flavin Transformation by Bacteria

FROM a lactoflavin solution which had become blue fluorescent, a bacterial species has been isolated capable of changing the usual green fluorescence of the flavin solution, and of developing a blue fluorescence When a very small amount of these bacteria, taken from agar, is put into each of two tubes, one containing aqueous flavin solution, the other only water, the following observations can be made

1 The green fluorescence of flavin often disappears in about an hour, due to reduction, and may be recovered by shaking with air

2 In any case the intensity of the green fluorescence becomes gradually less At the same time a blue fluorescence develops in the solution The final disappearance of flavin takes about 12 hours with fresh bacteria and 0 6 γ per c c of lactoflavin More than 3 γ per c c of lactoflavin in the solution is toxic, and no change occurs

3 The tube containing water and bacteria, but no flavin, does not develop a blue fluorescence No visible growth occurs in either tube

4 A tube containing the same amount of flavin under sterile conditions continues to fluoresce green indefinitely

Brewers' yeast and *Clostridium acetobutylicum*, both of which contain flavin, do not effect a similar change in flavin solutions, nor does *Mycoderma cerevisiae* The bacteria concerned, after drying, give an alcoholic extract showing no green (flavin) fluorescence, but only blue

The blue-fluorescing substance, either extracted from the bacteria or formed in a flavin solution by a small amount of bacteria, is extractable by chloroform It may be extracted from chloroform by alkaline water. The blue fluorescence has the same intensity from *p*H 12 to *p*H 5, but disappears in more acid solutions It is not affected by hydrosulphite, or by bromine

The organism is a Gram-negative rod, occurring in pairs (diplo), and apparently non spore forming a possible relationship to Coli bacteria is being investigated

The nature of the blue fluorescing substance, and of its apparent production from flavin by this and other organisms, is being studied The wide distribution of lactoflavin in Nature, and the existence of a related, blue-fluorescing substance (lumichrome), give these observations special significance

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Nov 15

Cosmic Radiation and Stellar Evolution

IN connexion with the recent hypotheses[1] that some of the components of the cosmic rays are ions, it may be noted that the emission of high speed ions from stars would reduce their mass by the same amount as if these ions had been annihilated in the manner suggested by Jeans. The emission of a proton from a star represents the same loss of stellar mass as the transformation of a proton and an electron into a quantum of ultra γ-radiation.

Thus the emission of cosmic radiation in the form of heavy ions from stars may reconcile the theory of stellar evolution suggested by Eddington's mass luminosity law and the Russell diagram (which seems to require stellar lives of the order only possible if we assume an Einstein - de Sitter universe with a time scale of 10^{13} years), and the Friedmann-Lemaître cosmology with an expanding universe, which suggests that the age of the stars is of the order 10^{10} years, for the emission of heavy ions in such intensity as is indicated by the cosmic ray ionisation observed at high altitudes suggests that stellar mass may decrease appreciably during 10^{10} years, since in addition to the loss of mass due to the emission of heat and light radiation, there is the decrease due to the actual ejection of stellar ions probably of high mass.

The process of stellar evolution in the downward direction of the Russell diagram would thus suggest (if the short time scale of the expanding universe is adopted) that the cosmic ray ions are mainly emitted from the heavier stars; and by main sequence stars in passing down the sequence According to this suggestion, the low mass of the white dwarfs (which are usually assumed to represent the final stage of stellar evolution) shows, therefore, that cosmic rays are entirely *emitted from the younger stars, and* it is probable, therefore, that the white dwarfs emit practically no radiation in the form of cosmic rays

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[1] Blackett, International Conference on Physics 1934 Compton and Stephenson, *Phys Rev*, 45, 441, 1934

Formulæ and Equations in Nuclear Chemistry

IN the advance proofs of the International Conference on Physics, held in London and Cambridge in October 1934, and in other recent publications, the Italian authors write the mass-number and *atomic number of the element on the right; for* example, He_2^4, Cl_{17}^{35}; the English authors write them *diagonally*, for example, ${}_2He^4$, ${}_{17}Cl^{35}$, and the French authors on the left, thus, ${}_2^4He$, ${}_{17}^{35}Cl$ When dealing with molecules it is essential to leave a space on the right in which to indicate the number of atoms as in the English formulæ, H_2O. Cl_2, or the French formulæ, H^2O, Cl^2, etc The Italian scheme blocks both positions and cannot be used by chemists, the English scheme cannot be used by French chemists, whereas the French scheme is convenient for all nationalities and might with advantage be adopted internationally. It has the incidental advantage that, when the numbers are printed vertically above one another, and are not staggered as in the Italian scheme, it is particularly easy to see by subtraction the number of neutrons in the nucleus.

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Dec. 12.

A New Magnetic Alloy with very Large Coercitive Force

WHILE investigating the magnetic properties of metallic neodymium containing about 7 per cent of iron (the sample was kindly lent to us by Prof. Hopkins of Urbana, Ill.) we found that this material is strongly ferromagnetic. Its specific magnetisation (near saturation) in a field of 20,000 Oersted is about 13 at room temperature.

It is rather difficult to assert at present whether we are dealing with a homogeneous alloy of iron and neodymium, or whether the finely dispersed iron is imbedded among the neodymium grains. The value of the specific magnetisation seems to correspond to about 7 per cent of free iron. Yet the material investigated by us shows an extraordinarily great coercitive force, reaching 4,300 Oersted with a remanent magnetisation equal to 70 per cent of the maximal temporary value. This enormous coercitive force, so far as we know, has never been observed either in pure iron or in any of its alloys Thus we may conclude that these remarkable magnetic properties are due to a hitherto unknown iron alloy.

We are examining the nature of this alloy and we hope to publish soon elsewhere further details concerning this problem

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V DROŽŽINA
R. JANUS.

Ascorbic Acid and Thiosulphate in Urine

To investigate the metabolism of vitamin C, one can determine the content of ascorbic acid in urine by means of titration with 2 . 6 dichlorophenolindophenol in acid medium An interfering reducing substance is present in relatively large amount in the urine of diabetics and also in that of cats, and to less extent in the urine of normal persons and dogs ; this has proved to be thiosulphate.

The thiosulphate can be separated from the ascorbic acid by means of precipitation with mercuric acetate (a method used to remove cystein, ergothionein and glutathion[1,2]) and by precipitation with barium salts.

Details of the operation will appear in *Acta Brevia Neerlandica*.

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Nov 22.

[1] Emmerie, *Biochem J* , 28, 268 , 1934

[2] Emmerie and van Eekelen, *Biochem J* , 28, 1153 , 1934

Points from Foregoing Letters

LORD RAYLEIGH finds that helium gas can pass not only through silica glass but also through gelatine and celluloid. He suggests that the gas passes between the individual crystals that compose these materials. Single crystals of quartz do not allow the passage of helium, but beryl, which has an exceptionally open crystal structure, does

Alloys of thallium-lead or thallium-bismuth (Bi_5Tl_3) when rendered supra-conductive by cooling below 4° K., allow electromagnetic fields above certain critical values to penetrate them Prof. W. J. de Haas and Mr. J M. Casimir-Jonker give the relation between the value of the critical electromagnetic field and the temperature.

Experiments with supra-conductive materials are also reported by Mr N. Kurti and Prof F Simon, who have determined the transition points for zirconium (0·70° K), hafnium (0·3–0·4° K) and other metals. From these experiments and others with mixtures of a metal and paramagnetic salt, the authors hope to observe the effect (entropy) due to the change of distribution of the spin of atomic nuclei at very low temperatures (0·01°–1·0° K) The authors, using the magnetic method of producing very low temperatures, have reached a temperature of 0·04° K. with iron alum.

The recent deaths of Prof. W. M. Hicks and Sir Horace Lamb prompt Sir Joseph Larmor to contribute a few historical remarks on vortex theory, and to direct attention to one of its unsolved aspects of importance to aeronautic research, namely, whether a straight vortex cylinder fades from core outwards, and how rapidly.

From calculations based upon the wave-length of X-rays determined by the grating method, and also from crystal diffraction, Prof. Erik Bäcklin finds a value for the charge of an electron which differs appreciably from that obtained directly by means of electrified droplets.

Experiments on the relation between density and frequency of copulation in weevils lead Dr. S. MacLagan and Mr. E. Dunn to the conclusion that the organism automatically limits its own abundance, when other factors normally inhibiting population are not effective.

Certain mosquitoes (*Culex pipiens*) of British origin can lay eggs without a previous meal of blood Mr. J F. Marshall and Mr J. Staley report this fact, already observed with certain races of mosquitoes on the Continent, and ascribed to their adaptation to urban areas, where artificially heated buildings are common.

The electro-chemical potential (electromotive force) obtainable from the oxidation of hypoxanthine to uric acid (final stage of nitrogen compounds eliminated from the body brought about in the presence of enzymes existing in the liver, spleen and in milk), was found by Miss Filitti to be about − 0·400 and − 0·113 volts respectively. Mr D E. Green went more deeply into the theory of the reaction, and carried out further experiments, criticising previous work as not proved. Miss Filitti now points out that, as regards hypoxanthine, Green's findings confirm her own, while the xanthine-uric acid potential needs only a small correction due to their 'dismutation' (reversible change in absence of oxygen)

A bacterium which is able to destroy the usual green fluorescence of flavin solutions, producing instead a blue fluorescence, is brought to notice by Dr. L. Bradley Pett, who describes some of the properties of the blue fluorescent substance.

The theory of the expanding universe gives ten thousand million years as the age of the stars, while previous calculations based upon the rate of loss of mass (in the form of energy) necessitated a period a hundred times longer. Mr. H. J. Walke suggests that the discrepancy would be eliminated if the heavier stars give off not only radiant energy but also ions (which form part of the cosmic rays).

Neodymium containing 7 per cent of iron is found by Miss V. Drožžina and Mr. R. Janus to have great power of retaining magnetisation. The reversed magnetic field necessary to reduce its magnetic induction to zero (coercive field) is stated to be greater than that for pure iron or any of its known alloys, which suggests that the material investigated contains a hitherto unknown iron alloy.

Research Items

Population of Europe. Some comparisons of density and distribution of European population in 1720, 1820 and 1930 are made by Mr. J. Haliczer in *Geography* of December 1934. The data for 1720 involve various calculations back from later years and contemporary estimates. Those for 1820 include census figures for most of the States of Western Europe but, as in 1720, no data of any value are available for the Balkan peninsula. In 1930 reliable census figures are used. So far as comparisons are valid, Mr. Haliczer computes that the population in 1820 was 1·89 times that in 1720 and in 1930 it was 4·51 times that of 1720. Two centuries ago the population everywhere was sparse except in the Rhine valley, central Germany, the English plain and the Po basin. The regulating factor of chief import was then soil fertility, but the black soil area of southern Russia was almost empty. By 1820, the ranges between maximum and minimum densities were small, but industrialised areas were beginning to show marked increases. The peopling of the black earth region was beginning. By 1930 inequalities in density were very marked owing to industrialism, and in Russia the 'centre of gravity' of population had shifted south. A further estimate shows that in 1720 the 'centre of gravity' of Europe's population was about 45 miles east of Munich, in 1820 it was 14 miles east of Passau and in 1930 it had moved to 30 miles north of Vienna. In other words, it has shown a steady tendency to move east, thus decreasing the percentage of the whole population that inhabits western Europe. The total shift in two centuries is 124 miles.

Life-History of *Euphausia krohnii*. Miss Winifred E. Frost has described the occurrence and development of *Euphausia krohnii* off the south-west coast of Ireland (*Proc. Roy. Irish Acad.*, 42, (B), No. 3, 1934). Already in a previous publication (1932) she has considered the distribution of the larvæ of *Meganyctiphanes norvegica* and *Nyctiphanes couchii*, and the present paper is on the same lines. *Euphausia krohnii* is one of the species of euphausiids most frequently taken in these waters, and the adults occur in large numbers. It is interesting that Miss Frost finds the same number of furcilia stages which occurred in Mr. F. S. Russell's material from the Mediterranean (Lebour, 1926) and only these, three in all. No intermediate forms have ever been described, and this indicates the probability of the 'jumping' of several stages, which is apparently not unusual in deep-sea species. Eight cyrtopia stages are described which gradually lead to the adult form. This species is only found in waters of high salinity and is a typical oceanic species. Its normal habitat for living and breeding is on, and westward of, the Atlantic Slope. All the present material, with one exception, came from a depth of more than 100 fathoms, although some of the Mediterranean larvæ were found in only 17 fathoms. They are always found in water of a fairly high temperature. Breeding appears to take place almost throughout the year, with varying seasonal intensity.

Effect of X-Rays on a Sex Cell of Tobacco. In an investigation of the effects of X-rays in producing mutations in *Nicotiana Tabacum* var. *purpurea*, Goodspeed and Avery (*J. Genetics*, 29, No. 3) treated the megaspore mother cells to radiation at about the time of the reduction divisions. The resulting progeny showed a large series of variations. One of these was crossed with the control and the offspring were bred through five generations. In this way were obtained from the descendants of a single X-rayed megaspore 14 derivative types, 7 of which bred true. These types differed from the control in habit, form of leaf, flower and capsule, and in colour of leaf and flower, some of the types being so marked that they would rank as varieties or even species. Two types shown to be due to different genes bore stigmatoid anthers, another had pointed capsules, while the leaves ranged from broadly ovate to elliptic and the flower colour from carmine to rose and orange-red. Cytogenetic analysis showed that at least five of the 24 haploid chromosomes had been altered. Chromosome fragmentations had occurred, leading to homozygous duplications and deficiencies, as well as translocations and gene mutations. Probably plants which are homozygous for a chromosome deficiency can survive because the tobacco is a polyploid species.

Sclerotinia Rot of Patwa in India. Patwa (*Hibiscus sabdariffa*) is a fibre crop grown fairly extensively round the Pusa district of Bihar, India. It is sown with the monsoon rain in July, and is usually harvested for fibre in late October. A few plants to provide seed, however, are left until the end of February. The appearance of a destructive disease in December and January is therefore a serious menace to the continued propagation of the crop. Dr. B. B. Mundkur has studied this disease (*Indian J. Agric Science*, 4, Part 4, 758–778, August 1934). The fungus attacks the flowering stem, causing brown patches or cankers to appear on the surface. Black sclerotia may also appear, and frequently are found in the seed bolls. They are about the size of Patwa seeds, but are easily distinguished by their colour. The causal fungus has been identified as *Sclerotinia sclerotiorum* (Lib.), de Bary. Ascospores are produced from apothecia lying on the soil in November, and can infect unwounded, healthy plants. The optimum temperature for growth is 22° C. Hand separation of sclerotia from harvested seeds, combined with deep ploughing to bury sclerotia which may lie on the surface, are the control measures recommended.

Advance of Glaciers. In a recent paper to the Royal Geographical Society (November 19) on "Threatening Glaciers", Prof. K. Mason reviewed the evidence available regarding the movement of glacier snouts in the Karakorams during the last twenty years. He believes that substantial advance of the snout follows a period of degeneration or retreat, and that the rate of advance is controlled by topography. After the advance the snout takes some time to settle and if unenclosed is liable to spread. The variations in the dates of advance of various contiguous glaciers suggests that the advances cannot be due to climatic cycles. With some glaciers, periodic rapid advances occur. Prof. Mason thinks that these advances are due to accumulations of ice in the gathering ground either by avalanches, the advance of tributary glaciers or by normal snowfall. The accumulation is slow, and the outflow may be obstructed, but eventually the pressure becomes irresistible and the glacier advances. In discussing what could be done to mitigate disasters due to ice advances and associated floods, Prof. Mason believes the best plan is to study the intermittency of the glacier and so be able to predict its advance. If the causes are of the nature he suggests, no doubt the advances and retreats are rhythmical.

A Forgotten Indian Meteorite. In his presidential address to the Hyderabad Science Association in July last, Mohammad A. R. Khan, principal of Osmania University College, Hyderabad, directs attention to a recorded fall of a meteorite which was omitted from C. A. Silberrad's "List of Indian Meteorites" (*Min. Mag.*, **23**, 290; 1932). The circumstances of the fall referred to were recorded at the time by Jahāngīr in his memoirs, of which several translations are available. The meteorite fell in one of the villages of the Jalandhar district, Punjab, in 1621 (30 Fawardin, A.H. 1030) and was brought to the Emperor Jahāngīr, who ordered a sword, a dagger and a knife to be made out of it. The sword-maker found that the meteorite broke to pieces under the hammer, whereupon he was told to mix it with some other iron. This he did, using 3 parts of meteorite to 1 of 'common iron', and made two sword blades, a knife and a dagger, and brought them to Jahāngīr, who found they cut splendidly. The fact that the swords had been made was known to James Sowerby, who, in 1820, published in the *Philosophical Magazine* an account of a sword which he had made in 1814 for Alexander, Emperor of Russia, out of a piece of the Cape of Good Hope meteoric iron. In this instance, the blade was made from the meteorite without any admixture of other metal. It has been suggested by H. Blochmann that the Jalandhar meteorite was a stony iron or siderolite, and not a true meteoric iron, since it broke to pieces under the hammer. Its weight is given as 160 tolas (about 2 kgm.). Mr. Khan has published his address in an abridged form hoping to induce some of his readers to inquire as to the present whereabouts of the swords made from this meteorite. In an appendix he has collected published accounts of a recently recorded fall of meteoric iron at Bahjoi, south of Moradabad, United Provinces, on the night of July 23, 1934. One piece, the only one so far recovered, weighs nearly 23 lb.

Infra-Red Spectrum of Iron. The production of photographic plates sensitive to infra-red light has been of great value in the study of this part of the spectra of both laboratory and other sources. It has also, however, emphasised the need for accurate wave-lengths which can be used as a comparison in this region. The iron arc is a very convenient source of comparison spectra for most types of work, but the wave-lengths in the infra-red have not been satisfactorily studied. This has now been remedied by Prof. H. Dingle (*Mon. Not. R.A.S.*, **94**, 866) who has measured the wave-lengths of 68 lines between 8838 A. and 10219 A. The photographs were obtained in the first order of a 10-ft. concave grating, the overlapping second and third orders being used as comparisons for determining wave-lengths. The results are not proposed as ultimate standards, but are probably correct to within 0·01–0·02 A., and should be found of great value to those engaged in infra-red investigations.

Liquefaction of Helium. The liquefaction of helium, using the Joule-Thomson cooling effect, is ordinarily a costly process requiring large quantities of liquid hydrogen for pre-cooling. P. Kapitza (*Proc. Roy. Soc.*, Nov. 1, 1934) has succeeded in liquefying helium by adiabatic expansion, the expanding gas being made to do external work on a moving piston. The difficulty of lubricating a piston working at very low temperatures is surmounted by making the piston fit its cylinder fairly loosely. The loss of helium past the piston is reduced by making the expansion stroke very quickly, and the work is done against hydraulic pressure. The temperature is reduced in this engine to 10° *K* and the gas is finally liquefied by expansion through a nozzle, using the Joule-Thomson effect. Liquid air only is used for pre-cooling and when the apparatus is working, 2 litres of liquid helium are produced per hour, with a consumption of 3 litres of liquid air (see also NATURE, **133**, 708, 1934). This apparatus marks a very important advance in the technique of low temperatures.

Active Chlorine. Various workers have found that an abnormally active form of chlorine is produced by an electric discharge in the gas. E. J. B. Willey and S. G. Foord (*Proc. Roy. Soc.*, A, Nov. 15) have repeated and extended this work under more carefully defined conditions. No pressure charge was observed when an enclosed mass of chlorine was subjected to the silent electric discharge in an ozoniser, and no special optical absorption could be detected in the treated gas. The chemical reactivity was tested in several different ways. A marked increase in the reaction with water was observed when the chlorine was activated by a silent or spark discharge. The chlorination of benzene, both substitutional and additional, was used in much of the work as an index reaction. It was found that the activity was not produced without the presence of a small quantity of impurity, possibly a trace of water or hydrogen chloride. The experiments on this point were inconclusive, but it was thought that the reactivity is genuinely due to chlorine and not to a reactive impurity.

New Methods in Stereochemistry. The purification of crude *d*- or *l*-borneol, obtained directly from natural sources or by reducing *d*- or *l*-camphor, usually falls into two stages: (*a*) the separation of borneol from isoborneol, and (*b*) the stereochemical purification of the resulting borneol. J. Clark and J. Read (*J. Chem. Soc.*, 1773; 1934) now show that crude *d*- and *l*-borneol may be effectively purified by a species of auto-catalytic process. Thus, a specimen of commercial *d*-borneol was converted into impure *d*-bornylacetic acid; the impure *d*-bornyl *d*-bornoxyacetate obtained by esterifying this acid with some of the original *d*-borneol yielded stereochemically pure *d*-bornyl *d*-bornoxyacetate when fractionally crystallised; and upon hydrolysis this ether-ester yielded pure *d*-borneol and pure *d*-bornoxyacetic acid. In a similar way, pure *l*-borneol and pure *l*-bornoxyacetic acid were prepared from a specimen of commercial *l*-borneol. The method permits also of the preparation of stereochemically pure *l*-camphor from commercial *l*-borneol.

Physical Society's Exhibition of Scientific Instruments and Apparatus

THE Physical Society's twenty-fifth annual Exhibition of Scientific Instruments and Apparatus was held at the Imperial College of Science and Technology on January 1–3 It is interesting to recall that the first exhibition organised by the Society was held in the same College in 1905, and, except for the War period, it has been an annual event of outstanding importance in the scientific world Perhaps it is not too much to say that it provides the regular milestones for British scientific instrument manufacturers, much in the same way that the annual motor show does for the automobile industry.

In 1920 the Optical Society joined the Physical Society of London at these exhibitions, and in 1932 these two bodies amalgamated under the title of "The Physical Society". The first exhibition was open for one evening only and there were 17 exhibitors, nearly all of whom are numbered among the 110 organisations that took part in this year's exhibition In 1926 the Research and Experimental Section was added, it was divided into three groups The first, Group A, was intended to show "typical results of recent physical research of general interest and examples of new and improved laboratory methods", the second, Group B, was to include "little known and effective lecture experiments of interest to teachers of physics", while the third, Group C, was to provide an "opportunity for demonstrating repetitions of famous historical experiments in physics". This last group was discontinued in 1931

Largely at the instigation of the exhibitors themselves in general meeting, an annual competition in craftsmanship and draughtsmanship for apprentices and learners employed by exhibiting firms is now organised in connexion with each exhibition, and money prizes to the value of over £40, as well as certificates of honourable mention, are awarded each year The work submitted is exhibited in a special section Mr R W Paul, who has done so much to establish these competitions, writing in the February 1934 issue of the *Journal of Scientific Instruments*, says. "At present the principals of some of our leading concerns appear to take no active steps to encourage their apprentices to compete in the Craftsmanship Competition, so that the interest taken in the workshops varies greatly. Obviously the provision of facilities for executing the simple job which suffices to show an apprentice's skill involves some altruism on the part of a firm for the benefit of the industry, but regard should be had to the beneficial effect on the workers of the spirit of emulation aroused and the good effect on the morale of the shops The stimulus given by the competition to candidates is known in many cases to have had a beneficial effect on their careers. Further, it is believed the competition does something to raise the international status of our instrument trade"

The problem of providing the ever-increasing accommodation and supplies of electrical power necessary is one which, for the past few years, has taxed the ingenuity of those responsible. But with the valuable help of the College authorities and the co-operation of the exhibitors, it has been possible to arrange matters satisfactorily, although perhaps not ideally It must be remembered, however, that the Society receives the great privilege of free accommodation in the College, often at considerable inconvenience to the academic and research staffs No charge is made to exhibitors for their stands, who only participate at the invitation of the Society, and it is this feature among others which makes these exhibitions so different from the ordinary trade exhibitions Another noteworthy feature is that, in a very large number of instances, the directors and leading technical experts of the firms exhibiting are in attendance on the stands, so that competent replies are received to those highly technical questions which those genuinely interested must of necessity ask

The catalogue is now issued about a fortnight before the exhibition opens, and it is valuable as a handbook to be kept on the desk until the next issue appears Most exhibitors give a brief description of the principles underlying the action of the instruments and it is this that renders the catalogue so helpful A limited number of copies is still available and may be obtained from the office of the Society at the Institute of Physics, 1 Lowther Gardens, South Kensington, S W 7 (1s post free)

The Committee of the Society responsible for the organisation of these exhibitions strongly endorses the view of the Institute of Physics that it is desirable that firms and research organisations taking part in exhibitions organised by scientific societies should include the names of individuals associated with each of the exhibits. The entries in the catalogue for the past few years have displayed a desirable improvement in this respect, and credit is usually given to the designer and others responsible for the development of the various individual exhibits

Among the devices in the trade section this year were many examples of recent developments and improvements in electrical indicating instruments, galvanometers, radio instruments, relays, pyrometers, thermostats, humidity measuring apparatus, meteorological instruments, microscopes, projection and cinema apparatus, in addition to recorders, controllers and motors for numerous purposes. Representative collections of new technical books and journals were also shown. The recent rapid development of acoustics was represented by several exhibits, and the number of new illumination meters and applications of rectifiers which were shown was worthy of note In the limited space available here it is impossible to mention individual exhibits shown in the trade section, so many of which appeared to be of special interest and importance. Descriptions of the exhibits may be found in the various trade journals, in the catalogue of the exhibition, and in the February issue of the *Journal of Scientific Instruments*, which is devoted each year to accounts of the most important new devices shown in the various sections; summaries of the discourses will also be included in that issue of the *Journal*. We must be content here with brief reference to a few typical exhibits, which are mentioned for no other reason than to indicate the wide variety of instruments and apparatus shown. These are: an apparatus intended for the detection of cracks in iron or steel by local magnetisation; a device for determining the ripeness of fresh tomato juice; an electrical instrument for determining whether hunting by scent on any particular day is likely to be satisfactory; a special red light without heat for stimulating plant growth; and, of course, numerous examples of more ordinary instruments in new and improved designs.

The Research and Experimental Section provides always a fascinating display of the research physicists' work before it reaches the commercial production stage. Thirty-one of the research laboratories attached to Government departments, research associations, universities and manufacturing firms exhibited. Many of the devices shown had been developed for testing the properties and behaviour of a wide variety of materials under the differing conditions met with in practice, whilst several others were concerned with applications of cathode ray tubes and electron cameras to all manner of problems. One exhibit was staged to demonstrate the possibilities of ordering a number of different materials to match a given colour by quoting a standard name, number or code word, and another was designed for the routine measurement of the colour values of fabric and similar surfaces viewed by diffusely reflected light. Developments in the method of controlling the speed of small electric and mechanical motions by means of light tuning forks formed the subject of another exhibit. Others were, a galvanometer which is said to be immune from mechanical disturbance of the zero, despite violent pitching and rolling of the type met with in marine work, and a high speed motion picture timing system and camera which is said to take as many as 2,500 pictures a second.

Radio and telephony formed the subject of several important exhibits in the Research Section, and among these mention may be made of a standard receiver for the measurement of radio interference, a map of England and southern Scotland showing the electrical resistivity of the earth, and an 'artificial mouth' for testing telephones.

The growing use of discharge tubes for illumination purposes has led to the development of various devices for studying their behaviour, and some of these were exhibited. Another illumination device shown was a gas burner for producing an intermittent flame or light.

On each evening of the exhibition a discourse was delivered. The first was entitled "The Architecture of Molecules" in which Dr. B. Wheeler Robinson gave an account of recent X-ray investigations of molecular structure made at the Davy-Faraday Laboratory and elsewhere; the second was delivered by Dr. C. V. Drysdale on "The Problem of Ether Drift", a subject which readers of NATURE will know he has recently taken up with characteristic zeal; and on the third day, when the public is admitted to the Exhibition, the Astronomer Royal spoke on "Giant Telescopes".

The attendance at this year's Exhibition is not yet known, but in the past two years it has wanted but a few hundreds to be ten thousand. The Society is justly proud of the record of service it has rendered for so long to all those concerned with instruments, to the instrument industry in Great Britain, and to the public.

HERBERT R. LANG.

Biochemistry of Marine Phytoplankton

A SERIES of papers on "Observations on the Fatty Constituents of Marine Plankton" (*J. Exp. Biol.*, 11, 173–197, 198–202, 203–209; 1934) sheds considerable light on the content of fat and vitamins A and D in plankton, on which all marine animal life is dependent directly or indirectly for existence.

In Part 1, on the "Biology of the Plankton" by E. R. Gunther, in order to convey a more precise idea of the relative importance of each species, an attempt is made to translate by means of suitable measurements the figures representing the numbers of a species present in a given quantity of plankton into figures representing the volume occupied by that species. The oil content of May phytoplankton from near the Isle of Man was about 6·9 per cent on the dry weight, and it is suggested that the oil content may vary with the species and fluctuate during the life-history. The oil content of July zooplankton varied between 15 and 19·3 per cent. In plankton giving a high oil yield, *Calanus finmarchicus* was very prominent.

In Part 2, on the "General Character of the Plankton Oils", G. Collin, J. C. Drummond, T. P. Hilditch and E. R. Gunther show that the fatty acid fraction of the zooplankton oils resembled that from fish liver oils. In the non-saponifiable fraction they demonstrated the presence of cholesterol, cetyl and eicosoneyl alcohols, a hydrocarbon suggestive of squalene and possibly batyl alcohol.

In Part 3, on "The Vitamin A and D Content of Oils derived from Plankton", J. C. Drummond and E. R. Gunther describe the results of an examination of the oils by feeding tests, with antimony trichloride and spectroscopically. They show that the phytoplankton oil is more potent than the zooplankton oil in its growth-promoting action, and this is correlated with a greater richness in lipochrome pigments related to carotene. Vitamin A as such is apparently absent from both phytoplankton and zooplankton. In testing for vitamin D, the degree of healing was determined both by histological (line test) and by X-ray examinations. In daily doses of 50 mgm., phytoplankton oil showed no antirachitic activity but zooplankton showed slight activity. It is suggested that the small amount of vitamin D present in the animals results from their irradiation while in surface waters rather than from a prolonged diet of phytoplankton.

Building in Earthquake Countries

WE have received from Dr. C. E. Adams, Dominion astronomer and seismologist in New Zealand, several papers by Mr. R. W. de Montalk. In these, the author, who is an architect, describes a foundation, called the 'Salvus' foundation, that he has devised in order to lessen the effects of destructive earthquakes. It consists of a platform fixed to the ground. This is made of reinforced concrete, the under side of which may be strengthened, if necessary. Round the edge of the platform rises a rim of the same material, which contains a layer of clean fine shingle, 4–11 in. in depth according to the weight of the building. On this rests a slab, also of reinforced concrete, the foundation proper of the building, a space of about 4 in. being left between the walls and the inner edge of the rim

When an earthquake occurs, the platform and shingle move with the earth under the building, which, not being fixed to the ground, tends to remain still. It is claimed that the 'Salvus' foundation not only saves the building from damage or destruction, but also lessens the risk of fire during an earthquake and also the effects of wind pressure on the building, while the shingle itself provides an excellent damp-course The additional cost ranges from 1½ per cent for large city buildings to 6 per cent for dwelling houses.

It may be recalled that, fifty years ago, Prof. Milne experimented with a similar foundation in Japan, and that, still earlier, lamp tables resting on spheres had been used in Japanese lighthouses by Messrs Stevenson, the well-known lighthouse engineers[1] Milne's building, 20 ft. × 14 ft., was made of wood and rested on four iron balls, 10 in. in diameter These lay on saucer-shaped iron plates fixed on the heads of piles, and similar plates attached below the building rested on the balls From the records of seismographs placed inside, it was seen that, with an earthquake, there was a slow motion of the building to and fro, but that all the sudden motion or shock was destroyed Afterwards, in order to increase the rolling friction, Milne lessened the size of the balls until each pier of the building rested on a handful of ¼ in cast-iron shot The house then stood firmly during storms of wind and, with the earthquake of February 12, 1884, it remained practically unmoved[2].

C. D.

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[1] NATURE, 32, 213, July 2, 222, July 9, 316, Aug 6, 573, Oct 15, 625, Oct 29, 1885 33, 7, Nov 5, 435, March 11, 534, April 8, 1886

[2] "Brit Ass Rep", 248-249, 1884, *Inst Civil Eng, Min of Proc*, 83, 15, 1885

University and Educational Intelligence

CAMBRIDGE —The Clerk Maxwell scholarship for original research in experimental physics and especially in electricity, magnetism and heat has been awarded to H Carmichael, research student of St John's College The value of the scholarship is £210 a year for three years.

THE Royal Technical College, Glasgow, after four years of decreasing student enrolments, is able to report for the past year an increase, from 878 to 910, in the number of its day students, and although there was a small further decrease in the number of evening students (to 2,485) the aggregate number of hours of attendance shows an increase, and it is hoped that the downward trend since 1929 has at last been arrested There was a marked increase in the volume of advanced work Some indication of the exceptional range and standard of the evening classes is given by the fact that 95 graduates of the Universities of Glasgow, Edinburgh, Aberdeen, St Andrews, Cambridge, London, Leeds, Sheffield, Belfast, Allahabad, Calcutta, Dacca, Madras, Rangoon and Kyoto were enrolled The *Research Journal* inaugurated by the College ten years ago has published, in all, 167 original contributions by the staff and senior students, chiefly in the fields of chemistry (48), mechanical engineering (41), natural philosophy (25), metallurgy (16), bacteriology (14) and electrical engineering (11)

Science News a Century Ago

Airy receives the Lalande Medal

The Lalande Medal of the Paris Academy of Sciences, founded in 1802 by the famous French astronomer Jerôme de Lalande (1732–1807), was for some time the blue-riband of the astronomical world. In his "Autobiography", Airy recorded that in November 1834 "the Lalande Medal was awarded to me by the French Institut, and Mr Pentland conveyed it to me in December" The following year he recorded, "On Jan 9th 1835 I was elected correspondent of the French Academy, and on Jan. 26th Mr Pentland sent me £12 6s, the balance of the proceeds of the Lalande Medal Fund"

The Gallery of Practical Science

An advertisement in the *Times* of January 9, 1835, ran as follows "Gallery of Practical Science, Adelaide-street and Lowther-arcade, Strand.—The Grand Exhibition is re-opened to the public daily, at 10 o'clock—Steam-engine and carriages travelling on a Rail-road—Clifton Suspension Bridge—Magnets of extraordinary power, producing brilliant light and electric phenomena—Steam Gun discharging 20 balls in a second—Beautiful Illustrations in Optics—Steam Boat Models moving in water—Painting—Statuary—Music and many entertaining Novelties, including a splendid Microscope Admission to the whole 1s "

Sir Felix Booth made a Baronet

On January 10, 1835, the *Mechanics' Magazine* said "His Majesty has recently conferred a baronetcy on 'Felix Booth Esq, of Roydon Hall, in the county of Essex', avowedly for his public spirited conduct in fitting out at his own expense the expedition to the Polar regions under the command of Captain Ross Sir Felix Booth served the office of sheriff of London a few years ago, but on that occasion escaped the honour of knighthood, so often inflicted on the holders of that dignity, on some such important occasion as the bringing up of a loyal address It is believed that the present is the first instance of a civic baronetcy having been bestowed for services in the cause of science Captain Ross has also been knighted and received permission to wear the insignia of his numerous foreign orders in England " Sir Felix Booth was born in 1775 and died in 1850 Boothia Felix was named after him by Capt. Ross.

American Ice sent to India

In 1834, the American sailing ship *Tuscany* carried a cargo of ice from North America to India, and on January 10, 1835, the *Mechanics' Magazine* recorded that the master of the vessel had been presented with a handsome silver vase bearing the inscription: "Presented by Lord William Bentinck, governor-general and commander-in-chief of India, to Mr Rogers, of Boston, in acknowledgement of the spirit and enterprise which projected and successfully executed the first attempt to import a cargo of American ice into Calcutta " About 100 tons of ice was conveyed in the *Tuscany* The selling price was 6¼ cents per lb. and it was calculated that "the owners received 12,500 dollars upon an investment which including the cost of all the extra precautions for preserving the ice, did not exceed 500 dollars".

Societies and Academies

Paris

Academy of Sciences, December 3 (*C R*, 199, 1261–1344) L Lecornu. The abacus of Rateau The graphical method proposed by Rateau in 1897 for steam consumption in a steam engine is known by experience to give results not more than two or three parts in a thousand in error. The author shows that the equations on which this graph is founded are mathematically incompatible and discusses the reasons why, in spite of this fact, the results are so nearly correct Julien Costantin and Emile Miège The preservation in a cellar of potato tubers in the Moroccan Atlas and its effects Gabriel Bertrand and Virgil Ghitescu The elementary composition of some cultivated plants Analyses of five cultivated plants are given, special attention being given to the correct determination of the oxygen Possible errors in the results of other workers in the same field are discussed Armand de Gramont and Daniel Béretzki The velocity of propagation of sound in quartz The velocity of propagation of an ultra-sound wave along an electric axis is a function of the orientation of the bar. The extreme values differ by 22 per cent André Marchaud Continuous fields of convex semi-cones and their integrals E G Barrillon Radii of curvature of higher order attached to an analytical function Jean Leray. The problems of conformal representation of Helmholtz the theory of wakes and prows (of ships) —Henri Cartan The problems of Poincaré and of Cousin for functions of several complex variables G Dedebant, Ph Schereschewsky and Ph Wehrlé A class of natural movements of viscous fluids, characterised by a minimum of power dissipated The case of the sun J Chalom The reaction pump Jean Villey. The isotropy of the pressure in fluids submitted to very high accelerations Raymond Tremblot The applications of the heliometer to astronomical photometry The instrument described gives an accuracy of the order of one per cent, and requires less time than the usual method. Jacques Solomon. The experimental determination of electronic densities Max Born and Léopold Infeld. The principles of the new quantic electrodynamics. Schmitt. The determinations of the vapour pressures of hydrocarbons The author uses a static method with special precautions for eliminating gases from the liquid and from the glass surfaces. Results are given for benzene, *n*-hexane, methylcyclopentane and toluene. Théodore Ionescu and Constantin Mihul: The structure of the ionised layer of the atmosphere (ionosphere). The analysis of the results of experiments on ionised gases indicates that there is no thermal equilibrium between the electrons and the molecules, and hence the velocities are not distributed according to Maxwell's law. These results have been applied to calculate the reflection of the electromagnetic waves in the upper regions of the atmosphere. It is concluded that the discontinuities observed experimentally are only apparent and that the true reflection levels vary continuously René Dubrisay: The applications of a method of capillary analysis. Mladen Paić and Mlle. Valéria Deutsch. The refractometric determination of the seric proteins. W. Swietoslawski and J. Salcewicz: A new determination of the esterification constant in the gaseous phase co-existing with the liquid phase. The apparatus described, designed to eliminate the error produced by the change caused in the composition of the liquid phase by distillation, determines the constant with a possible error of 3 per cent Pierre Dubois The oxidation of manganous sulphate by hydrogen peroxide in an alkaline medium M and Mme. Edouard Calvet: The variations of the velocity constant of saponification by soda of amides in saturated solution René Jacquemain: Some bitertiary diols derived from diacetone alcohol (2-methyl-2 pentanol-4-dione) Henri Wuyts A functional exchange between magnesium compounds and α-bromocampher Gabriel Lucas The age of the strata of Sidi el Abed (Department of Oran) Robert Laffitte The facies of the Aptian, the Albian and the Turonian in Aurès (Algeria) Jean Cuvillier The *Kurkurstufe* in the Lybian desert and their position Raymond Charonnat and Mlle. Simone Roche. Fluorine in French mineral waters. A modification of J H. de Boer's colorimetric method has been used The examination of 150 mineral waters leads to some modification of the conclusions of Gautier and Clausmann. Jacques Duclaux. The transparency of the air to Wood's light A simultaneous measurement of the transparency and proportion of ozone in the atmosphere would give information of interest concerning the general movements of the atmosphere. E Rothé and F Stoeckel: The radioactivity of the geological strata of the Rhine valley Eugène Chabanier. The *p*H limit of growth of plants in the steppe regions Robert Bonnet and Raymond Jacquot The influence of antioxygens, of methylene blue and of nitrophenol on the growth, the composition and the energy yield of *Sterigmatocystis nigra* Louis Berger Sympathicotropic cells and cells of the internal theca in the human fœtal ovary. Ph. Joyet-Lavergne. The factors of cellular multiplication A discussion of the possible relation of vitamin A and glutathione in cell division. Mlle. Gilberte Mourot The synthesis of creatinic substances (creatinine and creatine) in the course of protein inanition

Leningrad

Academy of Sciences (*C R*, 3, No 7) V. Gogoladze. On the theory of retarding potentials. A Goldhammer. On the mechanism of viscosity in fluids V. Ioffe: The Kerr effect in solutions. A. Banov and N. Prilezhajeva: The fluorescence of vapours of ethylamine. V Sharonov. A new method of measuring the haziness of the atmosphere and visibility Principles of a new instrument are described N Melancholin. The pleochroism of minerals in an ultra-violet spectrum Ninety-five different minerals have been examined and considerable pleochroism has been found only in some tourmalines G Gamburcev. The use of mechanical filters in applied seismometry Theoretical considerations on which mechanical filters for high-frequency waves can be based A Dinzes and A Frost The mechanism of the thermal decomposition of hydrocarbons. Kinetics of the decomposition of ethane and of propane are discussed. C Ioffe and A. Shakina: The influence of water vapour on the velocity of the reactions in the charge of a glass furnace. The presence of water vapour, under pressure, accelerates the reactions between the components of the charge. A Guhl and R Dozorceva A contribution to the knowledge of sex determination in Hymenoptera. Two morphologically different types of sex chromosomes have been found in *Pteromales puparum* and this supports Whiting's hypothesis of sex determination in Hymenoptera. L DOBRUNOV. Problem of the relation of plants to the concentration of nitrogen in the nutrient solution Not only different species but also different varieties of the same species respond in a different way to the variation in the concentration of nitrogen in solution. I. VASILJEV · On factors of yarovisation of winter varieties The method of Lysenko is not the only and not the best one by which winter varieties of wheat can be made to mature in the same year The possibilities for accomplishing this are much more varied V CERLING and A CHEPIKOVA On the types of the yarovisation process (2) It appears that the yarovisation stage is a gradual process of the formation of new qualities with the accumulation of quantitative changes, rather than an immediate accession of new properties E SOTNIKOV. Production of citric acid by the fungus *Aspergillus niger* (3) I. KOZHANCHIKOV Water balance of the pupæ of *Agrotis* and *Ephestia* as a reaction to the humidity of the environment

MELBOURNE

Royal Society of Victoria, October 11 G. W. LEEPER: Manganese deficiency of cereals. plot experiments and a new hypothesis Experiments on an overlimed soil showed that $MnSO_4$ applied with the seed was beneficial, but sulphur in amounts sufficient to bring the *p*H below 6 7 gave the best yields of wheat grain Healthy alkaline soils differ from deficient soils in containing large reserves of 'active MnO_2' which are soluble in a 0 2 per cent solution of quinol in normal ammonium acetate at *p*H 7 0. This active MnO_2 is directly available to plants, whether in the colloidal state or by reduction at the root-soil interface (see NATURE, Dec 22, p 972) JEAN PHILLIPSON. Some algæ of Victorian soils. Thirty-four species of algæ have been identified from the Victorian soils, including nine Myxophyceæ, eighteen Chlorophyceæ, five Heterokontæ and two Diatoms This includes five new species and two new varieties. W. J HARRIS and D. E. THOMAS. Victorian graptolites (n.s) (3) A descriptive paper dealing mainly with Upper Darriwilian forms. W. J. HARRIS: The graptolite succession of Bendigo East, with suggested zoning. Attention is concentrated on the beds east of the Whitelaw fault, and it is shown that there is a succession descending towards the east from this line. The Uppermost Darriwilian zone (*D* 1) is divided into two zones, (*a*) with *Diplograptus* (? *Mesograptus*) *decoratus*, Harris and Thomas, and *Didymograptus nodosus*, Harris, as zonal fossils; and (*b*) with *Diplograptus* (*Glyptograptus*) *intersitus*, H. and T, and *Didymograptus compressus*, H and T., the former being the higher The zones between that marked by the incoming in force of *Diplograptus* (*D* 2) and of the Dicranograptidæ are grouped as a *Diplograptus* series, and a suggestion is made for the grouping of lower zones according to the chief features of their graptolite assemblages. LEO W. STACH: Victorian Lower Pliocene Bryozoa (1). Twenty-two species of Bryozoa are recorded from Macdonald's locality on Muddy Creek, one, *Otionella grandipora*, being new. All except *Arachnopusia terminata*, Waters, are recent forms, eight of which are initially recorded as fossils, the remainder ranging from the Lower Miocene to the present day. Six species of the Catenicellidæ are recorded, constituting the first record of this group in the Lower Pliocene.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, January 6

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 — Capt Guy Dollman "British Mammals" *

Monday, January 7

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION), at 8—(at the Chemical Society, Burlington House, London, W 1)—Prof T P Hilditch "The Fats: New Lines in an Old Chapter of Organic Chemistry" (Jubilee Memorial Lecture)

ROYAL GEOGRAPHICAL SOCIETY, at 8.30—A M. Champion "Teleki's Volcano"

Thursday, January 10

INSTITUTION OF ELECTRICAL ENGINEERS, at 6—A Monkhouse "Electrical Developments in the U S S R."

ROYAL EMPIRE SOCIETY (EDUCATION CIRCLE), at 8— Discussion on "The Background of Education in Papua", to be opened by the Hon R L. Turner.

MATHEMATICAL ASSOCIATION, January 7–8 Annual meeting to be held at the Institute of Education, Southampton Row, W C 1

A W Siddons "The Food of the Gods" (Presidential Address)

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Committee appointed by the Physical Society to consider and make Recommendations on the Teaching of Geometrical Optics Pp v+86 (London Physical Society) 6*s* net

University of Bristol Annual Report of Council to Court, 1933–34 Pp 48 (Bristol)

List of Geological Literature added to the Geological Society's Library during the Year 1933 Compiled by the Library Staff (No. 36) Pp iv+303 (London Geological Society) 10*s*

Tropical Diseases Bulletin Vol 31, Supplement Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year 1932 Summarized by Dr H Harold Scott Pp. 219 (London Bureau of Hygiene and Tropical Diseases) 5*s* net.

Amgueddfa Genedlaethol Cymru National Museum of Wales. Twenty-seventh Annual Report, 1933–34, presented by the Council to the Court of Governors on the 26th October 1934 Pp 42 (Cardiff)

OTHER COUNTRIES

Memoirs of the Geological Survey of India Palæontologia Indica, New Series, Vol 21, Memoir No 2 Cambrian and Ordovician Fossils from Kashmir By Dr F R Cowper Reed Pp vi+38+2 plates. (Calcutta Geological Survey) 2 8 rupees, 4*s* 6*d*

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga, June–October 1933 Section 1 Natural Science Research of the First Scientific Expedition to Manchoukuo By Shigeyasu Tokunaga Pp iii+76+69 plates Section 4, Part 1 Plantæ Novæ Jeholenses, I. By Takenoshin Nakai and Masao Kitagawa Pp iv+71+20 plates. Section 5, Part 1 · The Fresh Water Fishes of Jehol By Tamezo Mori Pp ii+61+21 plates (Tokyo Waseda University)

Harvard Meteorological Studies published by the Blue Hill Meteorological Observatory of Harvard University No 2 Subsidence within the Atmosphere By Jerome Namias Pp 61+3 plates (Cambridge, Mass Harvard University Press.)

School of Tropical Medicine, San Juan, Puerto Rico Report of the Director for the Year ending June 1934 Pp. 67 (San Juan · University of Puerto Rico)

Canada Department of Mines Geological Survey. Memoir 173 Slocan Mining Camp, British Columbia By C E Cairnes (No 2358.) Pp iv+137+13 plates 50 cents. Memoir 174 Surface Deposits and Ground-water Supply of Winnipeg Map-area, Manitoba. By W A Johnston (No 2363) Pp v+110 25 cents (Ottawa King's Printer)

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1934 (No. 2360) Pp. iii+44 (Ottawa · King's Printer) 25 cents

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Co-ordinating Agricultural Research

ORGANISED agricultural research in Great Britain is developing along lines similar to a modern industry The chief research centres confine their activities to one or a few aspects of agriculture, and in this respect may be compared to factory shops, in each of which the operatives concentrate on some particular stage of production and usually know little of the processes carried out in other shops This highly specialised type of organisation is one of the most economical that has yet been devised, but its success depends largely on the existence of a central executive body, capable of ensuring the closest co-operation and co-ordination between the different departments In recent years, the need for an analogous executive body to co-ordinate agricultural research in Great Britain has become increasingly apparent and has been accentuated by the present tendency to regard agricultural development as one of the most important parts of national policy When Government not only subsidises agricultural research but also determines agricultural policy, its obvious duty is to see that the money spent on research is used to the best advantage for the furtherance of its policy

In the other fields of applied science subsidised by national funds, co-ordination has for some time been effected through the Medical Research Council and the Council for Scientific and Industrial Research In 1931, the framework of the scheme for the national supervision of subsidised research was completed by the establishment, by Royal Charter, of the Agricultural Research Council, which has just issued its first annual report*

The chief duty of the Agricultural Research Council is to give advice on research to the agricultural departments and to the Development Commission, and to make recommendations with regard to the administration of the subsidies granted by the Treasury, amounting in 1931 to about £390,000 The Council works in close collaboration with the Medical Research Council and the Council for Scientific and Industrial Research, each of which must have at least one member on the Agricultural Research Council The work of the latter, however, is complicated by the fact that, when it came into existence, there was already an extensive agricultural research organisation operating under the Development Commission and the Agricultural Departments of England and Scotland. It is faced with the delicate task of adapting this organisation, initiated in 1911, to the economic and political conditions of the present time

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* Committee of the Privy Council for the Organisation and Development of Agricultural Research Report of the Agricultural Research Council for the Period July 1931—30th September 1933. (Cmd 4718) Pp 205 (London H M Stationery Office, 1934) 3s net

A danger which the research worker may foresee in the creation of a co-ordinating body controlled by Government is that political influences may be introduced into the direction of agricultural research The Council's report should allay all fears on this score, at least for the immediate future It has been written not only with exceptionally broad vision and a true appreciation of the present needs of agricultural research, but also in a most interesting and informative style

In the period covered by the report, the Council's main achievement has been to make a general review of British agricultural research This has involved more than a hundred meetings of committees and sub-committees, and frequent visits to twenty-two different research institutes In its future difficult task of co-ordination, which will demand the willing co-operation of all concerned, the first annual report will be of the utmost value not only to the Council but also to the directing bodies of institutes which may be called upon to modify their research programmes to fit the general scheme. The whole report forms a permanent and authoritative record of the progress and achievements of agricultural science up to 1933, and it illustrates in an exceptionally lucid manner the interconnexion of the different branches to form a single science

Every section of the report appears to have been adequately treated, although more prominence is given to veterinary research than to any other subject, and eight special committees have been formed to advise on the study of the chief animal diseases This, however, is in accordance with the policy of the Council to adapt the national research programme to the probable needs of agriculture in the immediate future The Council foresees a large increase in Britain's animal population as a result of recent legislation, and recommends that science should, so far as possible, forearm the farmer to cope with the inevitable spread of diseases —an essentially practical outlook which may arouse mild criticism from non-veterinarians who still believe that the discovery of a truth is of greater significance than its economic value But agricultural research workers, though they may regret the gradual encroachment of bureaucracy on the freedom of scientific investigation, have to recognise that they are primarily public servants whose first duty is to perform their allotted tasks in the social machine A slight loss of freedom is compensated by a greater sense of security in what is now formally acknowledged as a profession

The establishment of a national research council marks the beginning of a new epoch in the history of British agricultural science, and so long as the Council interprets its functions in the manner indicated in its first report, both research workers and institutes are assured of the fullest consideration compatible with a planned organisation

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Reviews

Population Prospects in the United States

Dynamics of Population. Social and Biological Significance of Changing Birth Rates in the United States By Frank Lorimer and Frederick Osborn Pp. xiii+461 (New York The Macmillan Co, 1934) 15s net

THIS book consists of four parts, the first of which, entitled "Population Trends of American Groups", discusses, in four chapters, first the trend of the national population, and then the three aspects of differential fertility, represented by the contrast between town and country, by racial differentiation, and by differences of social class. The writers realise that population growth in the United States will slow down, cease and change to population decline in the absence of any abrupt change in the trend of the birth-rate, or in the possibility of attracting immigrants They express a somewhat ostentatious indifference to the economic effects of this population tendency, which has already doomed the economic prospects of thousands of once hopeful small communities, and has forced the Federal authorities to consider a policy of deliberate depopulation of part of the vast area brought under cultivation by the enterprise of American farmers The authors state truly that the theory of optimum population is at present still in the stage of preliminary definition and clarification, and add, somewhat vaguely, "It may be that a higher standard of living for individuals could be maintained in this country with a population very much greater or very much less than 150 million," without reference to the fact that personal hopes, enterprise and investment, in addition to municipal, State and Federal policy, have in the past all been dominated and directed by the confident expectation that the resources of their territory were destined progressively to be more and more fully utilised

On the other hand, the authors believe, and later produce ample evidence for their view, that the "large differentials in reproduction rates among population groups" in their country need far more critical attention than they have yet received, and determine to devote the rest of the book to the study of changes taking place within this population This is not, avowedly, to be taken to mean that the authors consider eugenics more important than economics, but that they recognise that population changes may affect the composition and standards of a people, wholly apart from any changes in their genetic qualities "Children tend to be like their parents in part because they are usually brought up in an environment similar to that which has shaped their parents It is evident, therefore, that the differential increase or decrease of groups with varying social heritage may affect the proportion of different culture levels in our population, just as the differential increase or decrease of groups with varying biological heritage may affect hereditary capacities The study of both factors is important "

In the following chapter the authors demonstrate that, as in other countries, "there is at the present time a tremendous rural-urban differential in reproductive tendency," and quote Thompson and Whelpton on the current situation "If prosperity again permits a resumption of the movement of the surplus farm population to city jobs the present urban exodus may do little permanent harm If this should not occur, there is a danger of developing a large poverty-stricken population on the millions of acres of land which is submarginal for business farming, but which will permit self-sustaining farming on a low standard of living "

The authors consider "It is impossible to determine exactly, at the present time, the relative reproduction trends of whites and negroes in the United States", but evidently think there is no great difference They point to unusually high fertility for several minor racial groups, namely Mexican, Japanese, Chinese and American Indians They feel also that "there is little interest in the reproduction rates of foreign groups during the first generation of American residence, from the long range standpoint, because foreign groups become native groups in the second generation"

The longest chapter in this part is naturally devoted to the large differences in fertility between social groups, classified by occupation or by economic status. They find that these differences in fertility among urban social classes have remained fairly constant during the last fifty years, although the absolute rates for all classes have declined considerably during this period They add, however, "It seems very likely that differentials in fertility among social groups in the United States may become somewhat narrower in the course of the next fifty years " This anticipation seems not to be based on any American data, but on the somewhat credulous acceptance of recent not very well substantiated statements concerning several European cities, as to the validity of which it would be but prudent to reserve judgment

The methods and attitude of the authors have been illustrated above from the first of the four parts into which the book is divided Part II deals with the "Measurable Characteristics of American Groups", using, as before, regional racial and social sub-divisions Part III is devoted to the 'Influence of Differential Reproduction on the Characteristics of the American People" under the two headings of its social significance and its biological significance , while Part IV discusses the causes and control of population trends Causes are divided into physical and medical factors on one hand, and the economic and social factors on the other Under the possibilities of social control are discussed numerous current movements of thought and political action, which may be believed, with more or less reason, to affect the situation

In spite of the enormous field which the book is thus designed to cover, it does not suffer from compression, but more frequently from prolixity and occasionally from repetition The laudable aim of restricting the conclusions to those which can be based on ascertained facts has, of course greatly limited the field to be traversed As all who are familiar with the subject know, the material available for discussion would be still more greatly restricted had the authors required not merely that some objective data should be available, but also that it should be sufficient to warrant statistically valid conclusions It is a sound canon of science that, when they are available, well authenticated, and free from contradictions, direct observations must be preferred to all indirect inferences from other facts It is, however, a serious and rather widespread failing, particularly dangerous in the social sciences, to give such preference to findings based on data, while their consistency, accuracy, or relevance are open to serious question In any discussion of social causation we may find some ascertained facts of compelling authority, others which should not be neglected, and others which are entirely irrelevant Workers in the social sciences should remember that discussions of causation, even in the most exact sciences, invariably turn on the validity of some rationally connected system of hypotheses, and never wholly on direct observations. It is, naturally, in the latter parts of this book that the lack of a theoretical background, such as the economists have possessed for more than a century, is most severely felt This criticism should not be taken as denying to the authors a great measure of success in an immensely arduous undertaking

R A FISHER

The Endocrine Principles

Recent Advances in Endocrinology By Prof A T Cameron Pp vii+365 (London J and A Churchill, 1933) 15s

THE endocrine principles are of interest from three aspects, clinical, chemical and social, for there is often an attempt to ascribe differences of personality to their variations Recently it is on the chemical side that most progress has been made, many of the principles having been isolated in pure crystalline form and even synthesised, so that it is possible to make the physiological study of the mechanism of their action with material of definite composition and structure There is progress too on the clinical side, though these aspects are more a matter of controversy. Internal secretions are produced by the thyroid, parathyroid, pituitary and adrenal glands, by the islet tissues of the pancreas, the mucous membrane of the intestine and the organs of reproduction From these there has been isolated thyroxine, adrenaline, insulin and œstrin in crystalline form, and there is presumptive evidence for other compounds

Prof Cameron gives six chapters to the well-established endocrine principles and one to the more presumptive ones, and devotes a final chapter to their interrelationships He summarises what is known regarding their chemistry, their method of action, their physiology and their clinical behaviour. The book has an appeal, therefore, to the medical, as well as to the biochemical, expert. Each chapter has rather full references to the literature up to the end of 1932 and is appropriately illustrated.

Now that the structure of these compounds is known, it should be noted that they bear no relation to one another, and it becomes important to ascertain some clue as to their utility in metabolism This is still largely guesswork, but there seems to be a hint of some general relation to oxidation phenomena

The thyroid principle, for example, according to Plummer, exerts an influence on the oxidation proceeding in all the cells of the body and thus produces its actions · the behaviour suggests control of specific reactions. Insulin brings about the disappearance of glucose from the blood : it is undecided whether it facilitates glycogen formation or direct oxidation of glucose. Adrenaline likewise has an effect on the interconversion of glycogen and glucose Of the less-known endocrines, secretin is the most interesting · it appears, like insulin, to be a protein, and acts to stimulate the outflow of pancreatic juice and bile Mellanby considers that it is carried with the bile salts to the general circulation

The author devotes a final short chapter to endocrine interrelationships, particularly those of the pituitary, which through one or other of the several principles it secretes controls (1) the thyroid and therefore the oxidative processes, (2) the adrenal cortex and thereby muscular contractility (3) the development of the gonads and hence the secondary sex organs and secondary sex characters, (4) fat metabolism to some degree, (5) the water exchanges of the body

No additional words are required to emphasise the interest of the conception that crystallisable chemical substances of relatively simple composition are able to control so many effects in the organism, and it is easy to see the many ways in which slight variations in their production can be reflected. Further deductions from these facts soon take us outside the region of ascertained scientific facts and they are wisely eschewed by the author

When a selection has to be made from so large a quantity of material, it would not be difficult to find faults of omission or over-emphasis, but it would be unfair to criticise the author for these when so much has been achieved in bringing a difficult subject into focus for detailed study Prof Cameron's book will be of definite help to all interested in this field

A New Atomic Model

The Sub-Atoms. an Interpretation of Spectra in conformity with the Principles of Mechanics By William Mayo Venable Pp viii+148. (Baltimore, Md The Williams and Wilkins Co. London · Baillière, Tindall and Cox, 1933) 9s

THIS book describes an attempt to explain spectroscopic phenomena in terms of a model of the atom conforming to Newtonian mechanics. The author assumes the existence of 'sub-atoms', each of which consists of an ellipsoidal or similarly shaped mass of positive electricity, of charge e, on which rests a smaller negative electron (charge, $-e$). The linear dimensions of the sub-atoms are inversely as their masses, and the atom of any element consists of that particular stable association of sub-atoms which will explain simultaneously its mass, atomic volume and spectrum. For the lightest eight elements these considerations give a unique structure, but more work is required on the heavier atoms.

The production of spectra is most simply illustrated by the lightest sub-atom, which is identical with the atom of hydrogen If the electron is disturbed by an external stimulus it bounces, like an india-rubber ball on the earth, with a frequency which varies continuously as the amplitude decreases This is accompanied by the radiation of a continuous spectrum, the limiting frequency (for zero amplitude) of which is the Rydberg constant, R Similar bouncing of an electron in a molecule formed of two such atoms in line gives a continuous spectrum with limiting frequency, $R/2^2$, and the 'difference-frequency' between these two limiting frequencies gives the first line of the Lyman series Co-operation of more complicated molecules yields the other lines of the hydrogen spectrum By assuming equilibrium positions of the electron at different distances from the centre of the non-spherical positive mass, the characteristics of the secondary spectrum are similarly described in terms of difference-frequencies The theory is extended to explain the spectra of the other light elements as well as X-ray spectra, and a few remarks on certain cosmic problems are added

The author shows great ingenuity in interpreting the details of spectra, which he has taken the trouble to understand beforehand, and his idea is not to be ranked with certain fantastic alternatives to the quantum theory which have been suggested without knowledge of experimental facts It cannot, however, be considered—at least *in its* present form—as a serious rival to the current interpretation of spectra It follows facts throughout, often at a considerable distance, and it appears to be devoid of suggestions for increasing our knowledge. Moreover, there are many facts (for example, the existence and spectrum characteristics of isotopes), well accounted for by the quantum theory, with which it is not obviously able to deal at all

These defects would be considerably discounted if the theory were, as it claims to be, based entirely on Newtonian mechanics, but the behaviour of the atoms and molecules in producing spectra by no means follows inevitably when Newtonian laws are applied to the assumed structures In the last resort the theory requires postulates as arbitrary as those of the quantum theory, so that a satisfactory comparison can be made only on heuristic grounds, where it is not likely to survive The author is, nevertheless, to be commended for having produced a very interesting and suggestive hypothesis and for his diligence in developing it so far as he has done.

Science and Poetry

The Poetical Works of Kenneth Knight Hallowes Vol. 1. *1896–1934* Pp xvi+212+2 plates. (London. Methuen and Co, Ltd, 1934) 7*s* 6*d*. net

MR HALLOWES in his recent book has raised again an oft-discussed question and given some interesting illustrations of its possible solution The question is how far can poetry express and keep pace with the discoveries of science The illustrations are drawn from poems of Mr Hallowes himself, when on the Geological Survey of India in the years 1905–23 In speaking of these, it will be sufficient here to point out that Mr Hallowes has at least three of the essentials for carrying out the work to which he rightly attaches high importance He has an observant eye, a passionate love of Nature and a profound sense of one of the greatest truths which modern science has revealed, namely, that the earth and all that it contains are subject to incessant change, and that what we see, though the result of these changes, is often to the superficial glance quite different It is due to this apparently paradoxical transformation that Mr Hallowes owes some of his most telling word-pictures, for example, "From rock once molten fire blue speedwells bloom" Such pictures of transformation are, as we might expect, frequent in the work of a man who from the starting point of geology sets out on the work of a poet of science

How does science fare generally in the works of poets? Our contemporary bards tend to deal, in short and rather emotional fragments, with the psychology of persons or striking events. Such psychology is by no means scientific If we look at the older poets of rather larger scope, we find that the ideas of the Greek philosophers, who were also the men of science, were quite naturally expressed in verse There was no such barrier in modes of expression as have since arisen Then, with the Romans, we have the immortal poem of Lucretius, which actually puts into verse a great scientific hypothesis In the Middle Ages, Dante gives us in more poignantly human form the science and philosophy of his day. Among the moderns, it is noticeable that Goethe, the greatest poetic force of the nineteenth century, was also an important figure in the science of those times Wordsworth, Browning, Tennyson, Sellby Prudhomme, Alfred Noyes have all written poetry inspired by science One would be inclined to say that the general lack, of which Mr Hallowes speaks, is rather due to the dispersive, uncontrolled and rather aimless character of much of the writing and thinking of the present day than to any long-standing divorce between poetry and science.

F. S MARVIN.

Short Notices

Contribution à l'étude du peuplement zoologique et botanique des îles du Pacifique. Par L Berland, J. Berlioz, E. H Bryan, Miss E Cheesman, L Joleaud, L. Chopard, L Germain, A Guillaumin, K Holdhaus, E P Mumford, A M. Adamson, P Rivet, L. Seurat, C Skottsberg, E Topsent, C Vallaux. (Société de Biogéographie, 4) Pp iv + 288 (Paris Paul Lechevalier et fils, 1934) 70 francs

The volume consists of sixteen papers by specialists who deal with particular parts of the subject Two papers are geographical or geological, three are botanical, the remainder deal mainly with zoology, four of them with insects One must recognise that it is extremely difficult to cover the ground adequately, for there are parts of Oceania and certain groups among the plants and animals about which we possess no information at all But there are several important topics to which less than justice is done There is, for example, almost nothing about the butterflies—a very important group to the student of island faunas, for these insects have been carefully collected, and a connected account of them could have been written The birds also furnish an abundance of material, but the paper which deals with them is most indefinite, with facts about the birds of New Zealand and the Hawaiian Islands, but next to nothing on the avifauna of such well-known groups as Fiji and Samoa Attention must be directed to one error in fact it is stated that crocodiles occur in the Tuamotu islands, but actually their eastward limit is in the Santa Cruz, more than 3,000 miles to the west The error is important, for one of the authors, having extended the range of crocodiles across Polynesia, is inclined to regard them as evidence that the area has a 'continental' fauna

The critic must not forget, however, that, in the present state of knowledge, a work of this nature must inevitably be fragmentary Certain parts of it are excellent, for example, the general description of the distribution of insects by Holdhaus and the more specialised articles on Orthoptera and on Arachnida by Chopard and Berland The value of the book as an introduction to the subject would have been greater had more attention been given to completing the lists of references, and had special and general indexes been provided P A B

The Chemical Formulary. a Condensed Collection of Valuable, Timely, Practical Formulæ for making Thousands of Products in all Fields of Industry. Editor-in Chief, H Bennott Vol 1. Pp x + 595 (Brooklyn, N Y The Chemical Formulary Co.; London H K Lewis and Co, Ltd, 1934) 6 dollars; 27*s*. net

It is difficult to assess the value of a book of this kind until one has lived with it for years. Only then can one discover whether any process of trial or selection has led to the inclusion or exclusion of material, or whether—as appears to be the case in this instance—there is no kind of entrance examination prior to admission to its pages. The result is that we have a book containing a very large number of formulæ, some attractive in their simplicity ("Liquid brilliantine light mineral oil, perfume"), some intriguing in their application (such as artificial butter), and others—very many others—which involve the use of materials of undescribed (and hence presumably unknown) composition appearing under proprietary names It is true, however, that the book is accompanied by a folder quoting many such names, and stating the suppliers of the preparations

The great variety of recipes is classified in sections, but within the sections similar entries are not always in juxtaposition Some of the recipes are stated to be in use commercially, whilst others have been taken from patent specifications and the literature, sources which, the reader is reminded, are often subject to various errors and omissions In view of this fact and of the fact that the significance and application of a great many of the formulæ are intelligible only to those having specific technical knowledge, the ordinary person will not find that the book obviates any need for technical assistance. A A. E

Electron Tubes in Industry By Keith Henney Pp ix + 490 (New York and London McGraw-Hill Book Co, Inc, 1934) 30*s* net

In recent years great advances have been made in the use of electronic devices in industries outside the sphere of 'communications' Mr Henney's book should do much to further the advance The author, who deals with the varied and sometimes little appreciated applications of electron tubes, is closely connected with many sides of the world of electronics, and this book should find a place on the shelf of every industrial engineer

The first two chapters deal with electron tube theory and circuit application, and are sufficient to enable the engineer not familiar with these tubes to understand intelligently the various circuits employed The remaining chapters are devoted to the vacuum thermionic valve, the gas-filled tube, and to light-sensitive devices; the various industrial and laboratory applications given being chosen to demonstrate the fundamental principles involved The respective merits of the different tubes available are discussed both from theoretical and practical points of view, and the newer forms of tubes, such as the gas-filled relay, also have their place. An excellent bibliography completes each section

Isolated examples from the book will indicate the wide field covered; the use of the vacuum tube amplifier and photo-electric cell for automatic temperature control, the use of the grid-controlled gas tube as an inverter and commutator; these will be of particular interest to engineers, while physicists will also find the book of value, for many applications of the tubes, particularly in precision measurements, will make an especial appeal to them. M. B

Elektrische Gasentladungen ihre Physik und Technik Von A v. Engel and M Steenbeck Band 1 *Grundgesetze* Pp vii + 248 25.50 gold marks Band 2 · *Entladungseigenschaften, Technische Anwendungen.* Pp. viii + 352. (Berlin Julius Springer, 1932, 1934) 33 50 gold marks

THE first volume of this monograph gives an excellent and condensed account of the methods by which ions are generated and destroyed, and of the laws which govern their passage through a gas In the first part of the second volume the various forms assumed by the electrical discharge through gases are discussed, and so far as possible explained in terms of the conclusions reached in the first volume The treatment is intended as a necessary basis for the understanding of the conduction of electricity through gases, and does not pretend to be complete

The absence of any historical or critical survey is apt, perhaps, to encourage in the reader the feeling that a great deal more is known of the details of some of these processes than is actually the case, and that the explanations given and the data furnished are, in fact, correct. On the other hand, it is extremely easy to find the information which the practical worker in the field requires, and the clear graphs and tables render unnecessary those searches for data in the original papers which are so tedious and often so unsatisfactory This part of the monograph should prove valuable to those who must design or use apparatus employing gaseous discharge phenomena in the laboratory or in technical work

The second part of the second volume is too limited in scope to be of much value It describes various technical applications of the discharge through gases, but in far too superficial a manner For example, a reader who wished to use a Geiger counter would obtain little practical information from the description given M E O

Mathematical Problems of Radiative Equilibrium By Prof Eberhard Hopf (Cambridge Tracts in Mathematics and Mathematical Physics, No 31) Pp viii + 105 (Cambridge · At the University Press, 1934) 6*s*. net

THIS tract is an authoritative exposition of problems of radiative equilibrium by one of the original workers in the subject. An initial chapter gives a summary of the general theory and main problem to be treated, namely, the determination of the radiation field of a star when the coefficients of absorption and scattering, the emissivity and the law of scattering are given The method is based on the solutions of certain integral equations and is expounded in detail in the succeeding chapters, which deal in turn with the cases of purely absorbing and grey material in local radiative equilibrium (Schwarzschild-Milne model) and that of monochromatic radiative equilibrium with scattering but zero emissivity (Schuster-Schwarzschild model) On account of the rigorous analytical method employed, the book is one for the specialist rather than the general reader, and will prove a very useful guide for those interested in the subject.

An Introduction to Logic and Scientific Method By Morris R Cohen and Ernest Nagel Pp xii + 467 (London George Routledge and Sons, Ltd , 1934) 15*s* net

THIS book, by two American teachers of philosophy, helps to show how far the best representatives of logic in modern universities have travelled from the Aristotelian tradition which formerly prevailed. In an earlier generation Mill and Stanley Jevons, and later Neville Keynes, did much for the reshaping of the old formal logic, and for the development of an inductive logic which brought the subject into more vital relation with the methods of scientific investigation In more recent times, logical theory has made progress in different directions, so that for educational purposes an eclectic treatment of the whole subject is desirable Such a treatment is accomplished in this admirable book

The authors have, we think wisely, adopted a fairly conservative attitude towards the traditional views, with which they have sought to connect the newer work in exact logic In giving the main results of symbolic or mathematical logic, they have refrained from stopping across the boundaries between logic and mathematics They hold that the alternative systems of logic which have been worked out are really different systems of notation for the same logical facts Their illustrations, freely drawn from the natural sciences, are such as a college student may be expected to understand and appreciate We think highly of the attempt of the authors to provide a sound introduction to the principles of logic and scientific method

Recent Advances in Vaccine and Serum Therapy By Prof A Fleming and Dr G F Petrie (Recent Advances Series) Pp x + 463 (London . J and A Churchill, 1934) 15*s*

AN authoritative and up-to-date account of modern serological remedies and therapeutic and preventive vaccines is much needed by the medical practitioner, and this book should go far to supply this want Dr. Petrie deals with the serological side, including the treatment of snake, scorpion and spider bites, and Prof Fleming with the vaccines, including non-specific vaccine and protein therapy. The veterinary side of the subject is also considered by both authors.

Though primarily concerned with recent advances, the older work is referred to, and the volume, which is well produced and very readable, provides a comprehensive practical account of the whole subject A chapter is devoted to bacterial variation in relation to immunising power, and the importance of the 'rough' and 'smooth and 'H' and 'O' variants is detailed, and the work of Perry, Findlay and Bensted on the suitable strain of typhoid bacillus for the preparation of anti-typhoid vaccine is included. A lengthy chapter is devoted to the vaccine treatment of chronic rheumatic conditions, in the preparation of which Prof. Fleming is able to draw upon his own considerable experience.

A short bibliography is appended to each subject, and an index of authors as well as of subjects is included.

Arctic Meteorology*

By Dr G C Simpson, C B, C B E, F R S

In 1905 appeared Mohn's discussion of the meteorological records obtained during Nansen's drift across the north polar basin on board the *Fram* during the three years October 1893–August 1896 No one who is interested in polar meteorology needs to be reminded of the outstanding value of that great work, which has been for thirty years the source of practically all we know about the atmosphere over the Arctic Ocean

Now has appeared another great contribution to our knowledge of arctic meteorology, again obtained on the drift of a Norwegian ship and discussed by another outstanding Norwegian man of science When Mohn's work appeared, the name *Fram* was a household word to the whole civilised world, but how many people even in England know anything about the *Maud* ? Yet the *Maud's* sojourn in the Arctic, where she was engaged on the same enterprise of scientific research, was even longer than that of the *Fram*, and her scientific results no less valuable

Amundsen's successful dash to the South Pole was a mere episode in a project on which he had been working for several years : namely, to repeat Nansen's drift across the Arctic Ocean in the *Fram* In fact, he was on his way from Norway to the Bering Straits around Cape Horn when he changed his plans at Madeira and went to the Antarctic On his return to Norway he proceeded with his original plans ; but the old *Fram* was found to be nearing the end of a glorious life and was no longer fitted for such strenuous work Then the War broke out, but Amundsen did not relinquish his plans In 1916 he gave orders for a new ship to be built, on the lines of the *Fram*, but smaller ; on June 7, 1917, the new ship was launched and christened *Maud*

On July 18, 1918, the *Maud* left Vardø, with Amundsen in charge, the total ship's party being only nine men. The plan was to sail eastwards along the Siberian coast towards the Bering Straits and then turn northwards into the ice and drift with the pack across the Pole. That was the plan, but it did not eventuate . for seven years the *Maud* remained in the Arctic the greater part of the time, either frozen fast near the coast or drifting aimlessly to the east of the New Siberian Islands.

Luckily for him, and more so for science, Amundsen in 1917 invited H. U. Sverdrup, a young Norwegian who had never been in the Arctic before, to take charge of the scientific work of his expedition Sverdrup consented and was one of the two men who alone saw the expedition through, starting with the *Maud* at Vardø in 1918 and leaving her when she returned to Nome in August 1925

During the first three years, Sverdrup was the only trained scientific worker on board—Amundsen helped with the magnetic work but he was disabled for a long period with a broken arm—but in 1922 F Malmgren, whose tragic death after the disaster to Nobile's airship in 1928 will be fresh in the memory of most, joined the expedition as assistant scientist In these circumstances the amount of scientific work carried out on the expedition is amazing Observations of the first importance on oceanography, terrestrial magnetism, atmosphere electricity and meteorology were carried out , zoological, botanical and geological collections were made, and Sverdrup spent seven and a half months living with a little-known group of native nomads in order to study their language and customs, and characteristically enough during the whole time he was with them he made meteorological and magnetic observations

The volume on meteorology which has just been published consists of two parts : Part II (527 pages) contains all the data in 28 well-arranged tables, and Part I is a discussion running to 331 pages written by Sverdrup himself Naturally one compares Sverdrup's discussion of the results of the *Maud* expedition with Mohn's discussion of the *Fram* results There is one striking difference Mohn's discussion is limited almost entirely to working up the statistics of the observations, while the outstanding feature of Sverdrup's treatment is his investigation of the physics and dynamics underlying the observations. The difference is symptomatic of the great advance made by meteorology in the interval Thirty years ago meteorological observations, even in settled countries, consisted of little more than observations of pressure, wind, temperature, cloud and precipitation all made at the surface, and the meteorologist could do little more than find statistical relationships between them Such were the observations carried out on the *Fram*, and Mohn's discussion was necessarily statistical. On the *Maud* similar observations were made, and Sverdrup has treated them in the same way and quite as thoroughly as Mohn treated the *Fram* results ; so that the two sources of information support and supplement one another. In the *Maud*, however, many other observations were made, and it is Sverdrup's complete and able discussion of the light which these new observations throw on old meteorological problems which makes his discussion so interesting and valuable.

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* The Norwegian North Polar Expedition with the *Maud*, 1918-1925 Scientific Results. Vol II Meteorology. By H U Sverdrup. (Geofysisk Institutt, Bergen, in co-operation with other Institutions)

For the first time we have a mass of observations from the upper air in the Arctic obtained by sounding balloons, pilot balloons and kites. The observations of the upper air temperature made by balloons and kites, of which there were 162 ascents, reveal an unexpected and important distribution of temperature over the ice. The few previous measurements of upper air temperature made over ice in polar regions had led us to expect a marked temperature inversion near the snow-covered ground during the winter. In other words, that there was a 'cold layer' of air near the surface.

It was supposed that this layer was easily removed by the wind. The observations made on the *Maud* show, however, that this is not the case. All that the wind does is to stir up the layers quite near to the ground. In this stirred-up layer, as one would expect, temperature decreases with height, but above it the strong inversion remains and the normal fall of temperature with height does not set in, in any season, much below 1,000 metres. There are, therefore, three definite layers of air over the Arctic sea ice, (*a*) a layer, 150 m. thick in the winter, increasing to 500 m. thick in the summer, in which the temperature decreases slightly with height, (*b*) a layer in which there is a strong inversion, the top of which varies in height above the surface from 280 m. in the winter to 600 m. in the summer, (*c*) a layer probably reaching to the tropopause in which the temperature decreases with height in the normal way. The pilot balloon observations, of which there were 621, gave very complete information regarding the variation of wind velocity and wind direction with height.

The peculiar distribution of temperature and the observed variations of wind with height over the ice can only be caused by eddy motion set up in the lower layers of the air, and Sverdrup uses the results of his observations to test the various formulæ put forward by Richardson, Schmidt, Köhler and Hesselberg in their theoretical work on the eddies in the atmosphere. Sverdrup's discussion is a valuable contribution to a difficult subject, and the numerical values he obtains will be found of use in a number of problems.

The diurnal variation of temperature in polar regions has been the subject of much discussion since the writer pointed out in his discussion of the meteorological observations made on Capt. Scott's Antarctic expedition that there are two types of daily variation, in one of which the maximum amplitude occurs in a spring month and in the other in a summer month. The observations taken on the *Fram* showed a rapid increase in the amplitude after the return of the sun until April, after which it decreased to very low values in the summer months, while in McMurdo Sound the amplitude increased steadily from the appearance of the sun until the summer and then decreased again as the altitude of the sun decreased. The observations on the *Maud* showed the same type as observed on the *Fram*, and Sverdrup gives a new explanation. It has already been mentioned that the lowest layer of the atmosphere in which the eddies cause the temperature to decrease with height thickens from the winter to the summer. Sverdrup considers that the layer is warmed up by contact with the ground and, therefore, as it gets thicker it takes more and more heat from the surface. After the sun returns, the daily temperature range tends to increase as the altitude of the sun increases, but the thickness of the layer also increases and that tends to reduce the range. The actual course is due to the relative efficacy of the two factors, the solar effect being the stronger until about April and then the eddy effect predominates.

During the last three years, after Malmgren had joined the expedition, an increased number of observations became possible, and amongst these were measurements of the incoming solar radiation, the long wave radiation received from the sky, the temperature of the actual surface of the snow and the temperature of the ice at three depths below the surface. These data supply all the information necessary to calculate the flow of heat during calm weather to and from the surface, and one of the most interesting chapters in Sverdrup's discussion is that in which he uses the results of these observations to investigate the heat balance of the atmosphere over ice-covered surfaces. He calculates that the average minimum temperature on clear calm days in the winter should be − 38·8° C.; the observations give − 38·9° C. According to the calculations, the absolute minimum temperature over the frozen polar sea should lie between − 43·9° C. and − 49·5° C.; the actual observations taken on the *Maud* in four winters give values varying between − 41·7° C. and − 46·3° C. The lowest possible winter temperature at Arctic land stations is calculated to be between − 63° C. and − 75° C., the former being the more probable, the lowest recorded temperature is − 69·8° C. at Werchojansk in February 1892. By using the value of the 'eddy diffusivity' found from the kite and balloon observations, similar calculations are extended to conditions during the summer and in winds This discussion of the heat balance is of particular value for a large number of meteorological problems

During the latter part of the expedition, entirely new methods of observing amounts of precipitation and the formation of hoar frost were devised and successfully used, but lack of space forbids further reference to the fascinating results obtained This short article must be closed by a reference to the last chapter in the work, entitled "The Circulation of the Air" For the first time the new ideas of the Bergen school of meteorologists have been applied to the interior of the polar regions Depressions with their characteristic 'fronts' are recognised and their motion determined in so far as that is possible without synoptic charts There appear to be two main permanent 'fronts' in the Arctic on which depressions form in the winter months—one in north-west Siberia, near to the Bering Straits, and the other between Spitsbergen and Norway During the winter months the pressure distribution over the Arctic is found to be mainly anticyclonic, but the anticyclonic conditions are frequently destroyed by deep cyclones which form on these two fronts and progress eastwards and northwards into the centre of the polar basin In the summer the general weather situation is of a more cyclonic character, but the actual disturbances are small and weak compared with the deep winter cyclones

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Development of the Modern Broadcast Receiving Valve

THE specification of most modern broadcasting receivers contains an imposing list of titles describing the various thermionic valves employed in the set The simple terms, 'high-frequency amplifying', 'detector' and 'low-frequency amplifying', are now no longer sufficient to describe the type of valve and its function in a wireless receiver, and one is led to speculate whether those investigators who were responsible for the introduction of the terms 'diode' and 'triode,' about sixteen years ago, envisaged the possibility of the octode as a manufacturing proposition in 1934 In the presence of such attainments, it is useful to review the developments which have led to such a complicated valve Such a review, with special reference to the technique of the manufacture of receiving valves on a mass-production basis, was made by Mr S R Mullard in his chairman's address to the Wireless Section of the Institution of Electrical Engineers on November 7 last

The thermionic valve, in both the two- and three-electrode forms, was in existence prior to 1914, and its early development was considerably accelerated by the demands of wireless communication during the War period After this period, the main receiving valve available in Great Britain was the then well-known *R* type, comprising a cylindrical anode, spiral grid and a co-axial filament of pure tungsten. This valve was available for general purposes as a high- and low-frequency amplifier, a detector or as an oscillation generator Judged by present-day standards, the valve was very inefficient and, incidentally, rather expensive. Its chief extravagance, as a valve to be used almost universally with batteries, was its filament, the function of which was to produce an electron emission of one or two milliamperes The main improvements in this direction were the introduction in turn of the thoriated tungsten filament and the oxide-coated filament, which is in use in most modern receiving valves, the more recent development of the mains-operated valve has involved the necessity for electrically insulating the heater from the metal cathode carrying the oxide coating The use of a heated wire coated with oxides of one or more alkaline earths, such as barium and strontium, is reminiscent of the early work on thermionic emission carried out by Elster and Geitel about fifty years ago

Having placed the cathode in a fairly satisfactory position as an efficient source of electron emission, the valve designer has had to turn his attention to the provision of more than one grid and one anode in order to meet the requirements in the progress of receiving circuit technique. By means of lantern slides, Mr Mullard illustrated the constructional development of the valve up to the octode of quite recent production The desirability of keeping the overall size of the receiving valve approximately constant has necessitated the attainment of considerable precision in the dimensions and spacings of the electrode system, and the valve has therefore become, very largely, a machine-made article

The purpose of the introduction of the additional electrodes into the triode, and the functions fulfilled by the various types of modern receiving valves, are usefully described by A. L M Sowerby in a series of four articles in recent numbers of the *Wireless World* (September 21 and 28, October 12 and November 2) In the first place, the attainable amplification from a three-electrode valve, when used at radio frequencies, is limited by the coupling between the input and output circuits effected through the capacitance between the grid and anode This difficulty was overcome by the introduction of a screen-grid between these electrodes, and the tetrode is thus available as an efficient high-frequency amplifier It is also desirable to be able to vary the amplification of a stage without incurring the risk of distortion of the received signals, or of decreasing the effective selectivity This is conveniently carried out by making the control grid spiral of a non-uniform pitch, so that the amplification depends on the grid bias voltage provided for the valve Here we have the tetrode with variable mutual conductance between grid and anode circuits (variable-mu tetrode)

The above types of four-electrode valve suffer a limitation in use, which is due to secondary emission effects from the anode This drawback has been removed by the introduction of a third, or suppressor, grid, which is located between the screen grid and the anode, and is in direct electrical connexion with the cathode Thus we have arrived at the high-frequency pentode, which may or may not be provided with the variable-mu characteristic The pentode is also available as an output valve specially designed to deliver audio-frequency power to the loud speaker This valve is more sensitive and more efficient than the corresponding output triode, but necessitates rather more care in design and operation with a suitable output load

Wireless receivers of the supersonic-heterodyne type require the provision of a stage in which local oscillations are generated, and of another stage in which these oscillations are suitably combined with the incoming signals to produce oscillations of the beat-frequency for subsequent amplification The oscillation-mixing process may conveniently be carried out by using a hexode valve provided with two control-grids, one for the incoming signal and one for the local oscillations, and two screen grids to separate them from each other and from the anode The introduction of a fifth grid will enable the separate triode oscillator valve to be dispensed with, and we thus have the heptode or penta-grid convertor, as a self-contained frequency-changer unit for supersonic-heterodyne reception If it is desired to be free from the disadvantages of secondary emission, mentioned above, still another suppressor grid is required next to the anode, and we have arrived at the octode An alternative arrangement of the electrodes in a frequency-changing valve, involving a triode-hexode in one envelope, was referred to in NATURE of October 13, 1934 (p 577)

The introduction of the variable-mu amplifying valve described above has enabled a system of automatic volume control to be developed, by means of which overloading of the receiver by strong signals from a local station is avoided and also the effects of fading of weaker signals from distant stations are largely counteracted These results are achieved by making the rectified signal provide the grid bias for the variable-mu valve and so control the amplification of the stage To obtain the relatively large bias voltages required, it has become necessary to use a diode as detector , further, in order to avoid loss of sensitivity in the receiver as a whole, separate detectors are desirable for the signal rectification and for the automatic volume control These detectors are provided in the double-diode valve Such a valve requires a relatively small amount of electron emission, and this may be derived from a portion of the cathode of the triode or tetrode used for audio-frequency amplification of the signals after detection Thus we have arrived at the double-diode-triode and double-diode-pentode valves used in many commercial receivers of to-day

The development of these multi-electrode valves has necessitated the use of considerable ingenuity in the design and construction of valve bases and sockets ; for, except in certain high-frequency valves in which the connexion to one electrode is led out at the top of the glass envelope, all the electrode connexions are made by pins of the familiar type.

The Deutsche Physikalische Gesellschaft

IN the year 1843, Magnus was professor of natural philosophy at Berlin and created a physical colloquium, or, as the obituary notice in NATURE of June 23, 1870, says, "Graduates and undergraduates assembled round him once a week, to enjoy what he called physical conversations. Here students in turn reported on investigations recently published, the master criticising the report, and opening a discussion on those points which appeared to deserve a fuller explanation" From all accounts, Magnus was an inspiring teacher, and it was under the influence of this colloquium that, two years later, in 1845, six young physicists—Beetz, Brucke, Heintz, Karsten, Knoblauch and Emil du Bois-Reymond—founded a society which had as its object, first the communication of original papers, and secondly the issuing of an annual volume of reports on all publications of a physical nature which should have appeared during the year. The society went by the name of the *Physikalische Gesellschaft zu Berlin*, which in 1899 became the *Deutsche Physikalische Gesellschaft*, to indicate the nation-wide scope which it had attained. This Society is, then, celebrating this year, on January 14, its ninetieth birthday

Of the names of the original founders, probably only those of du Bois-Reymond and of Beetz are familiar to the average reader nowadays, but in spite of the aristocratic indifference of some of the older representatives of science in Berlin, the Society grew rapidly. Among the fifty-three members who joined in the first year, we find the names of Dr Helmholtz, Lieut Werner Siemens and G H Wiedemann, while Kirchhoff and Clausius joined in the following year A period of wonderful fertility was beginning for German physics, and practically every name of note during that period can be found in the lists of the Society

In 1882 began the publication of the *Verhandlungen*, which, from being merely a record of meetings and short notices, later, in 1899, became a reputed journal for the printing of original papers, particularly valued for its quick publication. Meanwhile, the *Fortschritte der Physik*, published by the Society, became celebrated for the care and accuracy of its short abstracts of original papers in physics appearing in all countries The fifty years celebration held in Berlin in January 1896 under the presidency of one of the founders, du Bois-Reymond, gave evidence of the prosperity of the Society, the membership of which then numbered about three hundred The first series of photographs taken by Rontgen with his newly-discovered rays was shown, and experimental demonstrations were given by, among others, E Warburg, Arons, Aschkinass, Neesen, Rubens, Goldstein, Nichols, W Wien and F Kurlbaum—a very respectable list of names!

The new life of the Society, as the *Deutsche Physikalische Gesellschaft*, may be said to have been initiated under the influence of a discourse which Planck—a name long respected and beloved among physicists the world over—gave in December 1900 on the laws of radiation His famous paper in which the conceptions of the quantum theory were first given to the world appeared a few months later On the experimental side Goldstein and Rubens were addressing the Society on the fundamental investigations for which their names are best known. At the beginning of the War, the Society numbered more than seven hundred members, and the *Verhandlungen* were publishing papers of the first importance

After the War, the Society initiated fundamental changes, which increased its influence both inside and outside Germany Local branches were founded in all the chief centres of physical research throughout the country, and, in conjunction with the newly founded society for technical physics (*Deutsche Gesellschaft fur technische Physik*, in the foundation of which, if I may obtrude a personal note, my old friend Hausser, whose death in 1933 at the early age of forty-seven years was so widely lamented, played a prominent part), yearly meetings were arranged, somewhat similar to our British Association meetings, but for physics only The most recent of these meetings was held last September at Bad Pyrmont, and nearly five hundred physicists attended

Changes which were widely felt outside Germany were made in the publications of the Society There were in 1920 two extensive publications which gave abstracts of the world literature in physics, the *Fortschritte der Physik* and the *Beiblatter* of the *Annalen der Physik* In place of these a single publication was issued, the *Physikalische Berichte*, which has attained a high reputation, outside as well as within Germany The abstracts are, in general, exceedingly good, and appear promptly In the same year, 1920, the *Verhandlungen* were discontinued, and in their place appeared the *Zeitschrift fur Physik*, under the auspices of the Society This publication is so well known to physicists in Great Britain as not to need commendation

The Society is a powerful agent for the promotion of physical knowledge and for international accord and co-operation in the search for scientific truths It now numbers some fourteen hundred members, of whom almost a third live outside Germany Its work was never more important than now, and on its ninetieth birthday, which is being celebrated in Germany as a jubilee, it will receive the congratulations and good wishes of physicists of all nationalities

E N DA C ANDRADE.

Obituary

DR THEOBALD SMITH, FOR.MEM R S

WITH the death on December 11 of Dr. Theobald Smith, there has passed away a great figure in the science of animal pathology Much of his life was spent in research on veterinary science, and his work illustrates the natural intimate connexion between human and veterinary medicine, for his researches were of so accurate and fundamental a character that they made far-reaching additions to knowledge of disease both in man and the lower animals The breadth of his outlook was remarkable and many branches of pathology have been enriched by his keen insight.

Theobald Smith was born at Albany, N Y., in 1859, and after taking the degree of Ph D. at Cornell in 1881 and of M.D. at Albany in 1883, he was appointed director of the Pathology Laboratory of the Bureau of Animal Industry in the U.S. Department of Agriculture in 1884, and his earliest work was recorded in the annual reports of that department.

From 1896 until 1915 he was director of the Pathological Laboratory of the Massachusetts Board of Health and was professor of comparative pathology at Harvard University from 1896 until 1915, when he was appointed director of the Animal Diseases Branch at Princeton of the Rockefeller Institute, where he was emeritus professor at the time of his death

The quality of Theobald Smith's work was recognised throughout the world, and in 1932 he received the Copley Medal of the Royal Society He was a foreign member of the Royal Society, the Paris Academy of Sciences, the Danish Royal Society and honorary member of many other scientific societies He was awarded the Manson Medal of the Royal Society of Tropical Medicine of London, and received many other scientific honours.

The best known of Theobald Smith's discoveries was that of the relation of ticks to the disease known as Texas fever or red-water of cattle In 1889 Smith and Kilborne accurately described the causal protozoon, *Pirosoma bovis* (*Babesia bigemina*) and in 1893 they showed that the disease was transmitted from one animal to another by the tick *Boophilus* (*Margaropus*) *annulatus* This was the first instance in which a protozoal disease of a mammal had been proved to be transmitted by an arthropod The cycle of the protozoon was complicated by the fact that the tick, after sucking the blood of an infected animal, fell to the ground and laid its eggs on the grass, and not until the eggs had hatched, after weeks, or months, were fresh cattle infected by the bites of the larval ticks By this work many obscure features of this serious plague of cattle were explained and several entirely new factors in epidemic and epizootic disease were disclosed

The time when Theobald Smith began his work was one of rapid advance in bacteriology, especially in the direction of describing new bacteria associated with special diseases His observations were often of striking originality and related rather to the manner of action of bacteria, but they were often unheeded and forgotten, to be rediscovered later by others The discovery of new phenomena appears to have been his chief interest though the subjects at which he worked had eminently practical aims, and his career illustrates the fundamental value of informed and intensive observation by those engaged in work on practical issues It has come as a surprise to many to learn that with D E Salmon in 1886 he showed that a culture of bacteria killed by heat if inoculated into a warm-blooded animal—a bird—gave protection against a lethal dose of the same living micro-organism. This was the first recorded use of a dead vaccine, though the discovery is commonly attributed to Pfeiffer, who in 1896 began a long series of fundamental experiments on the same subject. Another early observation, reported in 1895–96, was the occurrence of a "peculiar disease" with deep and subcutaneous hæmorrhages causing the death of guinea pigs in four to eight weeks if they were fed only on oats and bran without any green food This appears to be the first description of scurvy in the guinea pig, which has been used as a valuable indicator of scorbutic diets in research on vitamins in recent years Smith, however, did not mention the similarity to human scurvy, but was concerned to show that this deficiency in the food led to the death of animals inoculated with a bacterium innocuous to guinea pigs fed on a normal diet.

In 1889 Smith began a series of investigations into the chemical products and growth requirements of bacteria, which were continued for many years and led to results of much practical and theoretical value in bacteriology The chief of these observations were on the differential fermentation of sugars, the reducing power of bacteria, and the oxygen and carbon dioxide needs of different species and races of these micro organisms Among the characters of bacteria which most interested him was their capacity for variation in virulence and in other ways In 1895–96 he published a paper on the existence of two kinds of tubercle bacilli exemplified by strains from a bear and a bull respectively, and in 1896 he correctly described the differences between human and bovine strains and the forms of disease which they produced, anticipating Koch's better-known statement on the same subject in 1901.

Another early but neglected observation, published by Smith with Reagh in 1903, concerned the non-motile varieties of certain motile bacteria, and the distinct agglutinins which were produced in animals for the flagella and bodies of the bacteria These important facts were rediscovered in 1917 by Weil and Felix Smith made a number of new observations on the culture of the diphtheria bacillus and on its toxin, and in 1910 he showed that balanced mixtures of toxin and antitoxin could be used to induce immunity to infection In this way he laid the foundation of the present methods of protecting man against diphtheria

Smith's zeal for the advancement of knowledge for its own sake is seen in the story of his discovery in 1904 of anaphylactic shock in the guinea pig resulting from a second injection of horse serum The symptoms had often been seen by others and wrongly interpreted This discovery he communicated to Ehrlich by letter, and the first publication on the subject was by Otto in 1906 in a paper on "Das Theobald-Smithsche Phänomen der Serum-uberempfindlichkeit"

In 1922 appeared his work on the first milk or colostrum of cows which, if taken in the first two or three days of life, protected calves from otherwise dangerous infections From among his numerous other original investigations may be mentioned those on the form of streptococcal mastitis of cows which may convey serious infections to man through the milk, on the forms of contagious abortion in cattle due to ***Brucella abortus*** and to the ***Spirillum abortus*** which he discovered, and on sarcosporidia He continued at work in apparent health until last summer

In 1934 were published Smith's Vanuxem lectures on "Parasitism and Disease" in which he summed up the history and theories of parasitism and recorded his mature reflections on this fascinating theme, with little or no reference to the share which he himself had taken in its development.

DR. J. WALTER LEATHER

THE death of Dr. J. W. Leather on November 14 removes one of those who have been largely responsible, during the last forty years, for the development of scientific work in relation to Indian agriculture, and he cannot be allowed to pass away without some reference to his activities in this and other fields.

Born in 1860, at Rainhill in Lancashire, he entered his father's chemical factory at St. Helens after leaving school, and, when he had served an apprenticeship to chemical work there, he was sent, in 1883, to study chemistry under Kekulé at Bonn. There he stayed three years and left in 1886 with the degree of Ph.D. On leaving the University, the appointment of senior assistant to Dr. J. A. Voelcker, the consulting chemist to the Royal Agricultural Society of England, was offered to him, and he held this post for six years. During this time he developed very high technical skill in chemical work in connexion with agricultural problems, a skill which he retained throughout his career. He originated several new methods, and one of these—a process for the detection of castor seed in feeding-stuffs—is universally used at the present day. In 1891 he became professor of chemistry at the Harris Institute, Preston, but the call to his real life work in India came before he had really settled down there.

In 1892, as a result of the recommendations of Dr. Voelcker in his report on the improvement of Indian agriculture, the Secretary of State for India decided to appoint a chemist and an assistant chemist to the Revenue and Agricultural Department of the Government of India, and Leather was selected for the former appointment. It was in this appointment of agricultural chemist to the Government of India, and in that of Imperial agricultural chemist which followed it in 1906, that Leather did what may be considered his life work. There he remained with few intervals until 1916, when he retired and settled down in Malvern.

When Leather was appointed to India in 1892, the position he occupied led to his having to range the length and breadth of the country, studying and advising upon the various problems which were placed before him by the authorities of the various provinces. He was, in fact, the only chemist attached to all the agricultural departments in India. His activity was tremendous, but it was an almost impossible position. His publications during this period (most of which appeared in the *Agricultural Ledger* then edited by Dr. Watt) were varied and numerous. They include the first general account of Indian soils, the first series of analyses of Indian manures, studies of alkali and salt lands, studies of sugar-cane and the composition of the Indian varieties, and a multitude of other questions. On the whole, the conditions under which Leather worked at this time did not permit him to push any of his many inquiries to a final issue in the improvement of methods or the better utilisation of Indian resources. A summary of his work during this first stage of his Indian career is contained in his final report on the first five years of the work of the Agricultural Chemist to the Government of India, issued in 1897.

The more congenial part of Leather's Indian work came in 1904, when the Imperial Research Institute at Pusa was founded, and he settled down as the head of the chemical department at that Institute, as Imperial agricultural chemist. As a result of his activities there, we have a series of publications, most of them published as memoirs of the Department of Agriculture in India. These deal with such subjects as the water requirements of crops in India, the composition of Indian rain and dew, soil temperatures in India, the problems of drainage and the loss of water from the soil in the tropics, and the interaction of calcium carbonate and carbon dioxide in soil under tropical conditions. It cannot be said that the work he did was of an epoch making character, but he gave us a very useful collection of data which did not exist before, and which nobody else has gathered together. Within its limits, his results were always reliable, and for several generations many workers will bless the name of Leather for the careful observations which can form the basis for real agricultural advances to be initiated by others.

So far as his work generally was concerned, Leather was essentially a laboratory worker. Of his industry there was no doubt, while he had a great capacity for friendship, and there are many who look back to their association with him as a time when they were initiated into that close study of a limited objective which was the special characteristic of his work.

H. H. M.

WE regret to record the deaths on January 2, as the result of an accident in the Austrian Tyrol, of Mr. Kenneth F. Armstrong, aged twenty-five years, and Mr. John Howard, aged twenty-six years. Mr. Armstrong was associated with his father, Dr. E. F. Armstrong, in the preparation of monographs on the glycosides and the carbohydrates, and Mr. Howard was a research worker at the Fuel Research Station, Greenwich.

WE regret to announce the following deaths:

Capt. J. E. Bernier, known for his explorations of the Canadian Arctic, on December 27, aged eighty-two years.

Sir Maurice Craig, consulting physician in psychological medicine to Guy's Hospital, on January 6, aged sixty-eight years.

Prof. Roland B. Dixon, professor of anthropology in Harvard University since 1916, an authority on the languages and culture of the Indians of the Pacific coast, on December 20, aged fifty-nine years.

Sir Alfred Ewing, K.C.B., F.R.S., formerly professor of mechanism and applied mechanics in the University of Cambridge, lately principal and vice-chancellor of the University of Edinburgh, on January 7, aged seventy-nine years.

Mr. J. C. Lawson, University lecturer in classics in the University of Cambridge, an authority on Greek folk-lore, on January 5, aged sixty years.

News and Views

The Right Hon. Sir Herbert Maxwell, Bt, K T, F.R.S.

ALL who love Scotland, whatever may be the grounds of their affection, will join in the tribute of congratulation and wishes of good will to Sir Herbert Eustace Maxwell of Monreith on the celebration of his ninetieth birthday on January 8 He has shown himself a most loyal son of a race noted for pride in its motherland, and as much as any writer since the days of Sir Walter Scott, he has successfully interpreted to his fellow-countrymen, as well as to the southerner, the charm, never too obvious, of the Scottish countryside in all its variety, and the romance of the chequered and turbulent course of Scottish history Here he has ranged from the making of Scotland and the high adventure of the Bruce to the lowly annals of the hamlet, obscurely and imperfectly preserved in local tradition and place-names His numerous studies of national and local history, the latter especially in his own Galloway, deserve well of Scottish students, but archæologist and historian alike are no less indebted to him for his activities as president of the Society of Antiquaries of Scotland and as chairman of the Royal Commission on Scottish Historical Monuments in practical affairs relating to Scottish history and archæology Sir Herbert's literary achievement has covered a wide field—from romance and fiction, history and biography, including a life of the Right Hon W H Smith and a survey of the first sixty years of Queen Victoria's rule, to "British Freshwater Fishes", but he is most at home when he seeks to convey the interest and charm of the birds and beasts of his own countryside, the trees of the woodlands and the flowers of a Scottish garden Here, indeed, *nihil tetigit quod non ornavit*

Prof. D'Arcy W. Thompson, C.B., F.R.S.

ON December 23, Prof D'Arcy Wentworth Thompson completed the fiftieth year of his tenure of a professorial chair, for he was appointed professor of biology in the newly founded University College of Dundee in 1884. Fresh from the biological renascence in Cambridge under Michael Foster and Frank Balfour, the young professor found in Dundee every possible kind of discouragement, scanty endowment, mean and unsuitable buildings—and the depressing atmosphere of an industrial city The title of his chair was soon changed to that of zoology, and in the closing years of the century the incorporation of the College in the University of St. Andrews, and the establishment of a medical school, brought a small increase in the number of his students. In 1917, on the retirement of his senior colleague, Prof W. C M'Intosh, D'Arcy Thompson was transferred to the chair of natural history, which he still occupies, in the United College at St Andrews. Fortunately, the time has not yet come to sum up or to pass judgment upon D'Arcy Thompson's achievements. His innumerable friends, however, and his pupils—none too numerous, alas !—will join with us in congratulating him on the jubilee of his professorship Few men of our time have been so much at home in both the fields of the old and the newer learning He is, we believe, the only holder of a chair of science who has been president of the Classical Association, and there must be many among those that have passed through his class-room, who found in an elementary course of lectures on zoology at least the beginnings of a liberal education

A National Institute of Science for India

THE Calcutta correspondent of *The Times* reports on January 7 that —"The Governor of Bengal has inaugurated a National Institute of the Sciences of India, of which the object is to promote scientific knowledge in India The institute will act through national committees, and will serve as a national research council for the undertaking of work of national and international importance required by the public and the Government Dr L. L Fermor, Director of the Geological Survey of India, is the first president " From this report it would seem that the new body is to combine the characteristics of a National Academy of Sciences and a National Research Council, but it is difficult without further details to know how it is related to existing organisations in India

IT may be remembered that in 1930 an Academy of Sciences was formed in the United Provinces, with its seat at Allahabad Later, there was a movement for the establishment of an Indian Academy of Sciences through the development or affiliation of the U P Academy or by the formation of a new body It was suggested that the ancient Asiatic Society of Bengal might appropriately become such an All India institution, and with the view of considering the whole matter a committee was appointed by the Indian Science Congress to prepare a report Without awaiting the recommendations of this Committee, Sir C V Raman, now director of the Indian Institute of Science, Bangalore, himself registered the title of "The Indian Academy of Sciences", and the *Proceedings* of this Academy, similar in format to those of the Royal Society of London, began publication in July last There are thus now two academies of sciences in India—one in Allahabad and the other in Bangalore, that is, in north and south India respectively There is plenty of room in the country for these two academies, but objections can be raised to either of them assuming the sole right to use the prefix "Indian", and it is not surprising, therefore, that Sir C. V Raman's action has caused a storm of protest No doubt the claims of different societies and places in India to recognition as centres of publication for the whole country have been considered by the committee of the Indian Science Congress. We await with interest the recommendations of the committee and trust that they will assist in removing the confusion which at present exists and will promote unity of purpose among scientific workers in all parts of the country.

British Art in Industry

On Friday, January 4, the Prince of Wales opened an Exhibition of British Art in Industry at the Royal Academy, Burlington House It is to remain open until March 9, and has been organised jointly by the Royal Academy and the Royal Society of Arts The chief aim of this large-scale experiment is to show the public that British manufacturers of textiles, glassware, furniture, etc , are alive to the importance of consulting artists, when designing their products The part played by science in rendering it possible to realise this ambition is not referred to nor perhaps could it be within the limited space available at Burlington House But the scope of the exhibition is wide, and especially striking is the increasing use made of synthetic resins such as bakelite in the manufacture of a great variety of household things Imperial Chemical Industries, Ltd , show a new form of this colourless plastic material (called Resin M) which it is claimed actually exhibits the sheen found in certain transparent natural crystals, and which can be carved and shaped into many beautiful objects The glass exhibit, too, is particularly important and interesting Then there are sets of furnished rooms of modern design, together with a vast display of fabrics, as well as some beautiful jewellery and metal work

The alliance of activities referred to above is assisted by the publication of an abridged account of the aims and work of the Royal Society of Arts, issued by and under the ægis of the Council of the Society, entitled "The Story of the Royal Society of Arts" (London John Murray, 1935 *3s 6d*) We read that in 1753, one William Shipley, residing at Northampton, published certain proposals for raising by subscription a fund for distribution through premiums, for the promotion of improvements in the liberal arts and sciences, manufactures, and so on Whereupon, in 1754, a Society came into being for the "Encouragement of Arts, Manufactures and Commerce in Great Britain" The organisation had no exact prototype at the time, and was under the obligation (like the later movement elsewhere by Count Rumford), of going forward, or going under It succeeded in the former process, and has thus achieved a hundred and eighty years of existence, which, however, have included interludes of vicissitudes Here we must leave reminiscent records to speak for themselves But it remains to recall that the Prince Consort became president of the Society of Arts in 1843, and was in office at the time of his death in 1861 Prince Albert's foresight and initiative were of signal value , since his death the interest of our Royal Family has been steadily maintained, strengthened and broadened in recognition of the Society, its aims of the present, and its outlook upon the future

Eumorfopoulos Collection

The announcement by Sir George Hill and Sir Eric Maclagan that the British and Victoria and Albert Museums, assisted by the National Art-Collections Fund and other donors, have secured the Eumorfopoulos collection for the nation is a source of intense gratification to a wide circle Not only is the collection of Far Eastern art made by Mr. George Eumorfopoulos the finest in existence, but also the combination of informed taste, opportunity and the necessary financial resources which has made its assembly possible is not likely to recur. The aesthetic, historical and scientific significance of these examples of the artistic activities in every form and material of the peoples of the Far East, and more especially of the Chinese, from the first millennium B C onward, has been made widely known by the generosity of its owner, as well as in monographs devoted to the study of specific examples or of classes of objects In future, a collection of the highest educational value will be available for the instruction of a wider public, more especially if as a whole or in part it should be incorporated in the much desired central Museum of Asiatic Art, which this acquisition may have brought a stage nearer Nearly one half the purchase money is available to be handed over forthwith to secure the immediate possession of a proportionate part of the collection An early and ready response to the appeal of Sir George Hill and Sir Eric Maclagan for contributions towards the balance of the cost will be a graceful recognition of the public spirit of the owner in accepting a relatively low figure for what is, in effect, a priceless collection

Professional Men and Research

An address entitled "A Talk about Research" was delivered by Mr W P Elderton to the Institute of Actuaries Students' Society on November 19 and has now been published The details of the address were highly technical, but the general principles laid down seem to be applicable to any profession, though they are on rather different lines from those suitable for workers in pure science at universities or research institutes Many young men would like to undertake some kind of research work, but they find it difficult to think of suitable subjects Of course, a genius would find his own problems and solve them Leaving aside such, as needing no guidance, some general advice can be given to those less original One way of starting consists of a study of the history of ideas on a certain subject, taking care to examine French and German sources as well as English This study will often reveal the inadequate foundation of current theories, and it will then naturally lead on to the attempt to replace the weak portions by something sounder. Another profitable and indeed indispensable task is the reconsideration of the professional practices that were established as the best in the past, in view of the change in contemporary conditions. Mr. Elderton warned his hearers against a hurry to rush into print. They should endeavour to take all possible precautions against error before publication, and to write in good English, so as to be intelligible to any diligent, well-informed reader. Controversy should be avoided, and when they think another writer has made a mistake, they should try to follow his line of thought and consider carefully whether the mistake is not their own. The advice of Francis Galton, "Never resent criticism and never reply to it", is good, though hard to follow by those not possessing Galton's saintly disposition and philosophical calm

Statistics and Inductive Inference

IN a paper read before the Royal Statistical Society on December 18, Prof. R A Fisher surveyed the recent change in the outlook of mathematical statisticians The most profound modification seems to have taken place rather in the logical than in the mathematical aspect, though it has been brought about by the resolution of mathematical difficulties Statisticians are now dealing with types of uncertain inference wider than those of the theory of probability Prof. Fisher expressed the view that the current teaching of pure mathematics is not an altogether adequate preparation for fruitful work in this field, for this teaching is purely deductive, omitting the essential concepts of inductive logic, and insists on 'rigour' in a limited sense which he considers very inadequate to the requirements of an inductive problem The questions raised by Prof Fisher are of great interest and importance, but it should not be overlooked that there is still some difference of opinion concerning them, as will be seen by a perusal of the series of papers in the *Proceedings of the Royal Society* (1932–4) by Dr H Jeffreys

Early Man in North America

DR FRANK H H ROBERTS, JR, according to a communication issued by the Smithsonian Institution, Washington, D C., has discovered in the foothills of the Rocky Mountains, in northern Colorado, a habitation site and factory of 'Folsom' man This discovery is of the greatest importance for American archæology, as not only is it the oldest known habitation site in America, but it is also the first occasion upon which there has been any indication of the mode of life of the peoples by whom the 'Folsom' points were made, beyond the bare fact that they were hunting tribes of a high antiquity —a deduction from the association of these points with the bones of extinct bison, musk ox and mammoth, known to have pastured at the edge of the ice-sheet The 'Folsom' points, it will be remembered, were first discovered five years ago at Folsom in New Mexico, and since then these finely-chipped flint implements have been found, frequently in association with extinct mammals, all over the United States from New Mexico to Virginia and Pennsylvania. It is thought by some authorities that they point to the existence of man in America several thousand years earlier than had previously been supposed Dr Roberts's discovery provides something of a cultural background for these scattered finds. The site he has now discovered rests upon a hard, chalk-like formation with about fifty feet of alluvial deposits above it. These must have been laid down very slowly. It is about a quarter of a mile in extent, but as yet only a small part has been excavated. The relics represent several camp sites occupied over a period of years. Flint nodules from which the implements were manufactured are plentiful Thirty characteristic points and a great variety of scrapers, rough stone blades, drills, engraving tools and hammerstones, with a large number of broken animal bones, have been collected

Antiquity

WITH its December issue, *Antiquity* completes its eighth year. The editor of the only free-lance journal entirely devoted to archæological matters is to be congratulated on his success in having carried through this enterprise successfully and without the assistance of any official organisation, in a period of exceptional difficulty. While there is undoubtedly a considerable public which is interested in archæological discovery up to a point, to hold that interest requires both tact and judgment The editor, whose aim is to present to his readers scientifically sound and accurate information of the latest movements in archæological discovery in a popular form, has a difficult course to steer, if he is to avoid the appeal to the sensationalism which flavours the news of 'finds' as it appears in most of the daily Press. On the other hand, the editor of *Antiquity*, both by his own 'tilting' in his unconventional notes and otherwise, encourages his contributors to an engaging freedom of treatment which in itself adds no little attraction to the pages of his periodical The contents of *Antiquity* of December illustrate these qualities admirably. If, for example, Mr Noel Myres' criticism of Dr Mortimer Wheeler's article in a previous issue on the topography of Saxon London ventilates further a subject which is of perennial interest to a wide circle, Dr. Wheeler's reply will appeal equally to those who appreciate learning worn lightly. Among the remaining contents of this issue, which are as a whole no less attractive, it is, perhaps, permissible to refer to the contribution by Sir George Macdonald on the Romans in the Middle East, which is an illuminating commentary on M A Poidebard's recently published air survey of the Roman frontier in Syria Like its predecessors, this issue fully supports the editor's appeal for an extended circulation to ensure the continued existence of a publication which is doing excellent work for archæological science by keeping its achievement before a wider public than is reached through channels of a more formal nature.

Thermo-remanence of Bricks

A LETTER has been received from Mr T. G. Bocking, Princes Chambers, 6 Corporation Street, Birmingham, 2, giving an account of some observations on the magnetic properties of bricks. Bricks were selected from a number of South Staffordshire kilns, the direction in which the bricks were lying when baked being noted. The polarity was most clearly marked when the bricks had been lying in a north-south direction, and it was found that the bricks were magnetised approximately along the line of magnetic dip. Among the bricks examined were some made from Etruria marl, containing about 11 per cent iron oxide. The kiln temperature was 1150° C. The content of iron oxide (mainly Fe_2O_3), to which such ferromagnetic properties may be attributed, varies considerably in the materials from which bricks are made. It is usually well below 2 per cent in the fire clays giving white and cream bricks, about 7 per cent in the clays giving red bricks, and 10 per cent or more in those giving blue and black bricks Among recent relevant investigations are those of Koenigsberger (*Phys Z*, **33**, 468, 1932) on hæmatite (Fe_2O_3), magnetite (Fe_3O_4) and other ferromagnetic compounds He finds that hæmatite, when cooled down in the earth's vertical field (0 4 gauss) from above the Curie point (about 670° C), shows a residual magnetisation which approaches the saturation remanence, and may be a considerable fraction of the saturation magnetisation It is, of course, not possible to generalise about bricks Each set of bricks presents a special problem, and precise discussion of the magnetic properties would require a detailed knowledge of the chemical composition of the clays, and of the conditions of baking and cooling It is, however, probably not widely realised that most bricks are magnets—though feeble ones, and Mr. Bocking's observations are of interest in indicating that the phenomenon of thermo remanence may be demonstrated with such a common object as an ordinary brick

A Remarkable Cloud Form

A PHOTOGRAPH of a remarkable cloud, of which a reproduction is shown in Fig 1, has been received from Prof. I. S. Astapowitsch, of the Astronomical Institute, Fontanka 34, Leningrad It was observed some time in 1932 at Stalinabad (lat 38° 34′ N., long. 68° 47′ E) above the Hissar Valley, and is described as having a rotational movement. Rotation round a vertical axis is strongly suggested by the appearance in the photograph of the middle and upper parts of the cloud. Students of cloud forms will recognise at once the very unusual character of this cloud, which has some structural resemblance both to the cumulo-nimbus cloud associated with a thunderstorm and to the funnel cloud of the tornado. By a curious coincidence, in a recent number of the *Meteorological Magazine* (Nov. 1934, vol. 69, No. 826) a sketch is shown of a cloud observed on October 4, 1934, near Waltham Cross, Hertfordshire, by Mr. Donald L. Champion, which has strong points of resemblance to the cloud just described. In each case a strong upward growth appears to have taken place over one part of a rather flattened cumulus cloud, the base of which was inclined to be convex, the central parts appearing to be lower than those farther from the centre. In the cloud near Waltham Cross the rapid vertical extension was formed in a few seconds, and after about five minutes the mushroom-shaped top spread out horizontally to form an 'anvil' cloud like those so often seen over thunder clouds In both cases it is likely that opposed wind currents and convexion, perhaps associated with local heating, may have combined to produce rapid ascent of air with rotation.

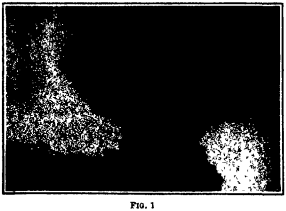

FIG. 1

Distribution of Birds at Sea

MOST ocean travellers must have noticed the very irregular distribution of birds on the open sea on different days, notwithstanding the apparently similar conditions of air and ocean Censuses made during the crossing of the Atlantic record statistically these differences, but little attempt has been made to suggest a satisfactory reason for them It seems very likely, however, that the presence or absence of pelagic birds is regulated by the oceanic currents, as S C Brooks suggests in the *Condor* (September 1934, p 185) Oceanographers have shown that where the Arctic Current meets the North Atlantic Drift, there arise complexes of eddies and upwelling of the under waters, and that at the margin of contact there is a surface display of abundant organisms which attract fishes and other predators This congregation of plenteous foodstuffs in limited areas may well attract pelagic birds, and Jesperson has already shown that there is a general connexion between the numbers of birds seen in a particular area at sea, and the quantity of macro-plankton in the surface waters Pushing the probabilities further, it is likely that the migrations of oceanic birds may be related to the movements of plankton, by whatever determined, and tentatively Brooks makes the very interesting (but quite untested) suggestion that one of the factors which guided the homing terns of Bird Key from Cape Hatteras, to which they had been conveyed, back to the Tortugas, may have been the rich feeding grounds along the margin of the Gulf Stream ' He adds that perhaps other factors too must be considered, such as the density of the air, which has been regarded as determining the northern limit of the distribution of the southern Atlantic wandering albatross.

Flora of West Lancashire Dunes

FOR some time, increasing concern has been felt amongst the botanists and Nature-lovers of this area for the dangerous position of the unique flora of the dunes of west Lancashire, particularly around Ainsdale. Recently two representatives of the Flora's League—a society for the preservation of wild flowers—

Dr. C. T. Green, president of the Liverpool Botanical Society and author of "The Flora of Liverpool", and Mr. Eric Hardy, librarian of the Liverpool Naturalists' Field Club, made a special survey of the present status of the flora, with the consent of the Royal Society for the Protection of Birds, to find whether the latter's sea-bird sanctuary on the dunes is also serving as a wild flower sanctuary. The dunes are unique for their profusion of *Pyrola rotundifolia* (round-leaved wintergreen) and *Parnassia palustris* (grass of Parnassus), probably more numerous there than anywhere else in England, and these flowers have been banned from the wild flower collecting sections of the Southport flower show in order to protect the dunes. The duneland orchid (*Epipactis dunensis*), which so far has not been recorded from any other part of the country, was found growing abundantly on the dry dunes, beside the pinewoods, and in the thinner pinewoods, its only enemy being the rabbits. The area is rich in Orchidaceæ. According to the records of the Liverpool Flora Committee, *Erythræa latifolia*, the broad leaved centaury, which was first described from those sandhills by Shepherd and Bostock a century ago and has not been recorded from any other part of the country, is extinct, though profuse enough at the time of its discovery. The last specimen gathered from the sandhills at Formby is now in the collection at the British Museum (Natural History).

Electrical Calculating Machine for Simultaneous Equations

A MECHANICAL calculating machine for solving simultaneous linear equations up to ten in number under construction at the Massachusetts Institute of Technology by Drs. V. Bush and J. B. Wilbur was referred to in NATURE of December 8 (p. 877). An electrical machine designed for the same purpose, also working up to ten equations, has already been designed by R. R. M. Mallock and constructed by the Cambridge Instrument Co., Ltd. A full account of this machine has been published (*Proc. Roy. Soc.*, A, **140**, 457, 1933) and a note on it appeared in NATURE of June 17, 1933 (p. 880). The machine itself is set up and at work in the Engineering Laboratory, Cambridge. It is stated that this machine can determine rapidly a set of roots to an accuracy represented by about 0·1 per cent of the largest root in favourable cases when the equations are well conditioned. The fundamental principle of the machine is to use a number of alternating current transformers, the coils of which are coupled up to such numbers of turns as to represent a set of equations of condition for the fluxes through the transformers which are the linear simultaneous equations to be solved. Such machines promise to be of great value in the very large number of problems which can be reduced to the solution of such sets of equations.

Physiographic Map of Japan

AN instructive physiographic map or diagram of Japan on a scale of about 80 miles to an inch is published by Dr. G. T. Trewartha in the *Geographical Review* of July. Japan lends itself to this treatment since about seventy-five per cent of the land is mountainous and the lowlands are mainly peripheral. The diagram brings out in a striking way the contrasts between the main structural regions of Japan, that is to say, the inner and outer zones running the length of the islands and meeting in fault scarps and tectonic depressions, except in central Honshu where the great zone of depression cuts across the country and the rift is partly filled by later accumulations. The outer zone of Pacific fold mountains appears as a series of well-developed longitudinal ridges and valleys with few noteworthy plains, but separated in the south by subsidence into isolated mountain masses. By contrast the inner zone appears as a rugged hill country of dissected block plateaux, some upheaved and others depressed with much volcanic activity. The Inland Sea forms a notable area of depression in this zone.

Tibet Earthquake of January 3

AN earthquake of moderate intensity occurred in southern Tibet early on January 3. According to the report issued from Kew Observatory, the first movements were recorded there at 2h. 0m. 58s., G.M.T., and at Bombay at 1h. 54m. 23s. The epicentre was estimated to be 4,600 miles from Kew and 1,150 miles from Bombay, or in about lat. 30° N., long. 88° E., the time at the origin being 1h. 50m., G.M.T. The earthquake, though not of unusual intensity, is interesting as its epicentre lay about 120 miles to the south of that of the great earthquake of last December 15 (NATURE, **134**, 963, Dec. 22, 1934).

Third International Congress of Soil Science

THE Third International Congress of Soil Science will be held in Oxford, on July 30–August 7 this year, under the presidency of Sir John Russell. The two previous congresses of the series were held in Washington in 1927 and in Leningrad and Moscow in 1930, and were notable for the exceptionally international character of the personnel and the discussions. The Congress will meet as a whole in six plenary sessions, at which a general survey of recent advances in every branch of soil science will be made, and it will also work in sections or 'commissions' dealing specifically with (1) soil physics, (2) chemistry, (3) biology, (4) fertility, (5) classification, and (6) technology. Three sub-commissions will discuss problems relating to alkali, forest and peat soils respectively. A 16-day excursion round Great Britain leaving Oxford immediately after the Congress, and terminating in Cambridge on August 23, is being arranged for the benefit of members wishing to obtain first-hand knowledge of British agriculture and soils. Every member of the Congress will receive a copy of the official transactions, including the full text of papers read at the plenary sessions, and detailed reports of the discussions at the Commission sessions. The cost of the transactions will be included in the Congress fee (£2), payment of which will also entitle members to attend all meetings, receptions, etc., held in connexion with the Congress. College accommodation during the Congress can be reserved through the Organising Committee Intimation of attendance at the Congress should be sent as soon as possible to the Secretary of the Organising Committee, Mr G V Jacks, Imperial Bureau of Soil Science, Harpenden, England, from whom all further information may be obtained

International Botanical Congress

A PRELIMINARY programme has been circulated of the Sixth International Botanical Congress, to be held in Amsterdam on September 2–7 of this year, under the presidency of Prof. F A. F C Went. An executive committee of Dutch botanists, with Dr M J Sirks of Wageningen as secretary, has divided the Congress into ten sections agronomy, cytology, genetics, geobotany, morphology and anatomy, mycology and bacteriology, phytopathology, palæobotany, plant physiology, taxonomy and nomenclature The presidents and vice-presidents of sections are already announced, as well as the topics chosen for discussion in each section, and some of the principal speakers The subjects for discussion include many of the current problems in all phases of botany, and some will be considered jointly by two or more sections A number of excursions to various parts of Holland are being arranged to follow the Congress

Announcements

THE second award, by the Wilhelm Roux Stiftung für Entwicklungsmechanik, of the medal founded in commemoration of Wilhelm Roux, who died on September 15, 1924, has recently been made to Dr Jan Boeke, professor of histology in the University of Utrecht, for his researches on the development of the nervous system

SIR LEONARD HILL writes "In my letter on 'The 1933 Everest Climbing Expedition and Oxygen' [NATURE, Dec 22, p 969], I say 'animals cannot live for more than six weeks' in oxygen equal to 10 per cent of one atmosphere. The words 'without serious deterioration' should have been added "

THE Royal Photographic Society, 35 Russell Square, W.C.1, is now holding its sixth exhibition in the series, "Photography in the Service of Mankind" The present exhibition is devoted to exploration and travel, and includes records from most of the great expeditions which have taken place during the last fifteen years The Exhibition will remain open to the public on week-days from 10 a m. to 6 p m until January 31

THE Iron and Steel Institute, in co-operation with other societies and technical institutions, will hold a symposium on the 'Welding of Iron and Steel" on May 2–3 The symposium, which will be held in connexion with the annual meeting of the Institute, will take place in the lecture theatre of the Institution of Civil Engineers, Great George Street, Westminster, London, S W.1 Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1

THE annual general meeting of the Institute of Metals will be held in London on March 6–7. On March 5, there will be an additional session with other technical institutions when a discussion will take place on "Problems of Cold Presswork", to be opened by Dr H J Gough. The discussion will be held at the house of the Royal Geographical Society. The annual May Lecture of the Institute will be delivered by Prof W L Bragg, whose subject will be "The Atomic Arrangement of Metals and Alloys". The annual autumn meeting of the Institute will be held in Newcastle-on-Tyne Further information can be obtained from the Secretary, 36 Victoria Street, London, S W.1

THE French Society for the Propagation of Cremation, founded in 1880, has nominated as its president Prof G Barrier, formerly president of the Academy of Medicine, in succession to the late Prof Léon Bernard, and Dr. G Ichok as general secretary. The offices of the Society have been transferred to 10 rue Fanny, Clichy, Seine

A COURSE of six public lectures on different aspects of "Time" will be given at Bedford College, commencing on January 17 The lecturers will be Prof F. C Bartlett (January 17), Dr. J K Fotheringham (January 31), Lieut -Comm R T. Gould (February 14), Dr R. A. Sampson (February 28), Sir Arthur Eddington (March 7), and Prof C D Broad (March 14) Cards of admission can be obtained from the Secretary, Bedford College, Regent's Park, N W.1

PROF F E FRITSCH, of Queen Mary College, London, has completed the first volume of the first comprehensive account in the English language of the morphology of the Algæ It is entitled "The Structure and Reproduction of the Algæ", and is designed for use by university students as well as by research workers The book will be published this month by the Cambridge University Press

A COMPREHENSIVE catalogue of zoological material for use in schools and colleges has been issued by Messrs E Gerrard and Sons, 61 College Place, London, N W 1 The 64 pages contain very complete lists of stock species, from Protozoa to mammals, for examination or dissection, of mounted specimens, injected and dissected, cartilaginous skeletons, and life-histories Prices are moderate, and our experience of the preparations, all of which are made by Messrs. Gerrard, is that they are of reliable quality

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in agriculture and warden at the Kent Farm Institute —The Principal, Kent Farm Institute, Borden, Sittingbourne (Jan. 21) A full-time physicist in the London County Council's Hospital Service—The Clerk of the Council, County Hall, Westminster Bridge, S.E 1 (Jan 25). A keeper of the Department of Geology in the public museums of Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool, 2 (Feb. 5) A University professor of physiology at St. Mary's Hospital Medical School—The Academic Registrar, University of London, S.W 7 (Feb. 15).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 72.

Disintegration by Slow Neutrons

FERMI and his collaborators[1] have reported that neutrons slowed down by collisions in substances containing hydrogen are captured by many nuclei very much more frequently than are fast neutrons. In the cases reported, the process is one of pure capture, resulting in the formation of a higher isotope. It is to be expected that slow neutrons may cause a nuclear transformation with the emission of heavy particles if energy can be released in the process. The probability of such a reaction will depend on the mutual kinetic energy and potential barrier of the resulting particles, and may be large when these quantities are of the same order of magnitude; this can in general only be expected for elements of low atomic number.

We have examined some of the lighter elements for such transformations. The general procedure was as follows. The element under examination was enclosed, as target or as gas, in an ionisation chamber connected to an amplifier and oscillograph and exposed to the bombardment of neutrons from a radon-beryllium source. A small number of ionisation 'kicks' was always observed, due mainly to recoil particles. The source and chamber were then surrounded by paraffin wax, thus exposing the target or gas to the bombardment of slow neutrons. In some cases, notably those of lithium and boron, a very large increase in the number of 'kicks' was observed, indicating that a nuclear transformation was taking place.

With lithium, the kicks observed were of two kinds, one due to doubly charged particles and one to singly charged particles. By covering the lithium target with aluminium foils we found that the singly charged particles had a maximum range of about 5·5 cm. in air, and that the range of the doubly charged particles was less than 1·5 cm. This suggests that the particles arise from the reaction

$$_3\mathrm{Li}^6 + {_0n^1} \longrightarrow {_2\mathrm{He}^4} + {_1\mathrm{H}^3}.$$

From the masses of the nuclei concerned, an energy release of about 5 million electron volts is expected, and a range of the H^3 particle which agrees well with that observed.

In the case of boron, the majority of the particles appear to be doubly charged and to have ranges less than 5 mm. in air. The only reaction which appears to fit the facts is

$$_5\mathrm{B}^{10} + {_0n^1} \longrightarrow {_2\mathrm{He}^4} + {_2\mathrm{He}^4} + {_1\mathrm{H}^3}.$$

A small but definite effect has been observed with nitrogen, and a rather doubtful effect with beryllium.

The most interesting feature of these reactions is their very high probability. The cross-section[2] for capture of a slow neutron by Li^6 or B^{10} appears to be of the order of 10^{-21} sq. cm., a magnitude which suggests that there is an attractive force between a nucleus and a neutron at relatively large distances. The above reactions afford a convenient and sensitive means for detecting the presence of slow neutrons.

J. CHADWICK.
M. GOLDHABER.

Cavendish Laboratory,
Cambridge.
Dec. 28.

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[1] Fermi, Amaldi, Pontecorvo, Rasetti and Segrè, *Ricerca Scientifica*, V, 2, 282; 1934.

[2] cf. Fermi, Pontecorvo, Rasetti, *ibid.*, 380; 1934.

Metaplasia of Uterine Epithelium Produced by Chronic Œstrin Administration

THE synthesis of polycyclic compounds possessing both œstrogenic and carcinogenic properties[1], the finding of considerable amounts of œstrin in cancerous tissue[2] and in the blood of tumour-bearing male mice[3], and the demonstration in various ways of a correlation between the amount of œstrin present in the body and the incidence of spontaneous mammary carcinoma (in susceptible strains of mice)[4] have led many students to suspect an interrelationship between epithelial growths and the female sex hormone. Metaplasia from columnar to stratified epithelium in the seminal vesicles and coagulating glands of male mice and rats treated with œstrin has been noted[5,6,7], but analogous effects in female animals have not been reported. Overholser and Allen[8] have found that treatment with œstrin and corpus luteum hormone enhances the atypical epithelium proliferation produced by traumatisation of the cervix uteri in monkeys; but since this proliferation occurred in a region in which squamous epithelium is normally present, it cannot be said whether metaplasia occurred or not.

Recently, a series of experiments were planned with the view of determining to what extent the 'anti-hormone' theory[9] might be found applicable. In one of these a group of eight female castrates were injected daily intraperitoneally with 30–60 γ of œstrone in oil (crystalline folliculin, kindly supplied by Dr. Girard) over a period of ten weeks. The mammary glands showed marked duct proliferation with some formation of alveoli; the degree of development was the same in biopsy specimens removed two weeks after the beginning of treatment as at the end of the experiment. Biopsy specimens also showed that the uterus and vagina preserved their œstrous development throughout the whole period. The experiment therefore confirmed the statement of D'Amour[10], that loss of sensitivity to œstrin does not occur. But when the animals were killed after ten weeks treatment, histological examination of their uteri showed in four cases a more or less complete metaplasia of the cylindrical secretory epithelium into a stratified squamous epithelium with cornification, from which irregular buds penetrated deep into the stroma.

In another experiment, 0·1–0 3 c c of 0·1 per cent œstrone in corn oil was placed in one horn of the uterus of each of six adult castrate female rats, escape of the oil being prevented by ligation of the uterus; the animals had previously been treated with moderate doses of œstrone intraperitoneally in order to distend the uteri The animals were killed on the fourth day after filling the uterus; the œstrin-treated horn showed signs of commencing metaplasia in three cases and complete metaplasia to stratified squamous epithelium in one case

H. SELYE
D L THOMSON
J B COLLIP

McGill University,
Montreal, Canada
Dec 18

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[1] Cook, Dodds, Hewett and Lawson, *Proc Roy Soc*, B, **114**, 272, 1934

[2] Loewe Raudenbusch and Voss *Biochem Z*, **249**, 443, 1932

[3] Engel, *Z Krebsforschg*, **34**, 658, 1931

[4] Lacassagne, *C R*, **195**, 630, 1932

[5] De Jongh, *Acta Brevia Neerl*, **3**, 112, 1933

[6] Lacassagne, *C R Soc Biol*, **112**, 590, 1933

[7] Burrows and Kennaway, *Amer J Cancer*, **20**, 48, 1934

[8] Overholser and Allen, *Proc Soc Exp Biol N Y*, **30**, 1323, 1933

[9] Collip, *J. Mount Sinai Hosp*, **1**, 28, 1934 Collip, *Annals Internal Med*, **8**, 10, 1934

[10] D' Amour, Dumont and Gustavson, *Proc Soc Exp Biol, N Y*, **32**, 102, 1934

Production of Electron-Positron Pairs

THE production of a pair of positive and negative electrons by two photons was one of the consequences of his theory of the electron first considered by Dirac. This effect is essentially at the basis of all pair production phenomena, and it may be of interest to point out that from the formula for it, recently given by Breit and Wheeler[1], we may readily deduce, to a certain approximation, the probabilities for the production of pairs by high-energy photons and electrons in the field of an atomic nucleus The correlation of these effects depends on the fact that for an observer moving relative to a nucleus with a velocity approaching that of light, the field of the nucleus is approximately equivalent to a radiation field. In the region effective for producing pairs—at distances from the nucleus of the order of and greater than $\hbar/mc$—the nuclear field corresponds, for an observer travelling with velocity v, to a distribution of photons the number of which in the frequency interval $d\nu$ is given by

$$N(\nu)d\nu = (2/\pi)\alpha Z^2 \log(g\gamma mc^2/h\nu)\, d\nu/\nu \qquad (1)$$
$$\alpha = e^2/\hbar c, \quad \gamma = (1 - v^2/c^2)^{-1/2}, \quad g \sim 1$$

The cross-section, σ, for pair-production by a photon, $h\nu$, of energy ξmc^2, $\xi \gg 1$, is now obtained by considering its interaction with the photons, which, according to (1), represent the nuclear field. For a system S', moving with the incident photon with a velocity such that the energy of the photon is reduced from ξmc^2 to mc^2, the expression for σ thus obtained is

$$\sigma = \int_{h\nu = mc^2}^{h\nu \sim \xi mc^2} \sigma(\nu) \times (2/\pi)\,\alpha Z^2 \log(g\xi\, mc^2/h\nu)\, d\nu/\nu. \qquad (2)$$

$\sigma(\nu)$ is the cross-section for pair-production by a photon of energy $h\nu$ and a photon of energy mc^2, travelling in opposite directions. The second factor is the number of virtual photons in the nuclear field with frequency in the range $d\nu$. On substituting for $\sigma(\nu)$ the expression given by Breit and Wheeler and integrating, this gives

$$\sigma = (28/9)\,\alpha Z^2\,(e^2/mc^2)^2 \log g\xi, \qquad (3)$$

which agrees with the result obtained by Heitler and Sauter by direct application of Dirac's theory. In this formula, and also the other formulæ given in this note, g is used to denote a numerical factor of the order of unity Its exact value in the different cases cannot be derived by the present method and this represents the degree of approximation involved.

The production of pairs in collisions between two electric particles may be deduced in a similar way, either by replacing the field of both particles by radiation and using the Breit-Wheeler formula, or only the field of one and using the Heitler-Sauter-Bethe[2] formula. Adopting the second procedure we obtain, as the cross section for the production of a pair, of energy between ϵmc^2 and $(\epsilon + d\epsilon)mc^2$ (including energy of mass), by an electron of energy ξmc^2, in the field of a nucleus, Ze,

$$\sigma(\epsilon)d\epsilon = (28/9)\,\alpha Z^2\,(e^2/mc^2)^2 \log(0{\cdot}15\epsilon) \times$$
$$(2/\pi)\,\alpha \log(g\xi/\epsilon)\, d\epsilon/\epsilon, \qquad (4)$$

being simply the product of the Heitler-Sauter-Bethe formula and (1) (remembering that for an electron $Z = 1$). If $\epsilon \gg 137Z^{-1/3}$, then in the first logarithmic term in (4) we must replace 0 15ϵ by $179Z^{-1/3}$, on account of the effect of shielding

The cross-section for the production of a pair of any energy, according to (4), is

$$\sigma = \int_2^{\sim\xi} \sigma(\epsilon)d\epsilon = (28/27\pi)\,\alpha^2 Z^2\,(e^2/mc^2)^2 (\log g\xi)^3. \qquad (5)^*$$

Regarding the pair-production by a high energy photon, it is of interest that, in the system S', to which (2) explicitly refers, the pair-production is practically all due to the interaction of photons of energy of the order of mc^2. This results from the fairly rapid convergence of the integral in (2), the integrand being asymptotically proportional to ν^{-2}. This is quite analogous to the state of affairs in the problem of radiative collisions, where the use of the Klein-Nishina scattering formula on the same lines as the present use of the Breit-Wheeler formula, shows that the emission of radiation by a high energy electron in a nuclear field may be reduced to the scattering of radiation of quantum energy[3] $\sim mc^2$. Both the pair-production formula and the radiative formula have thus a very simple theoretical basis.

A fuller discussion of the contents of this note and of other effects of charged particles which may be correlated with radiation effects will shortly be published in the *Proceedings* of the Danish Academy.

E. J WILLIAMS

Institute for Theoretical Physics,
Copenhagen.
Nov. 13.

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* (4) gives only the order of magnitude of $\sigma(\epsilon)$ if $\epsilon \sim 1$ or $\epsilon \sim \xi$. These regions of ϵ are, however, not important to the integrated cross-section It might be remarked that (5) is in harmony with the results for pair-production by 2 particles obtained by Landau and Lifschitz by direct application of Dirac's theory, in so far as their calculations are published (NATURE, 134, 109, July 21, 1934).

[1] *Phys Rev*, **45**, 766; 1934. The value given must be divided by 4 for use in the present connexion, according to a communication from the authors.

[2] *Proc. Roy. Soc.*, A, **146**, 83; 1934.

[3] Compare v. Weizsäcker, *Z. Phys.*, **88**, 612; 1934; and E. J. Williams, *Phys Rev.*, **45**, 729; 1934.

Absolute Value of the X-Unit

IN order to determine the ratio between the X-unit and the absolute unit of length, I have registered certain X-ray lines in high orders with a concave glass grating ($R = 5$ m.) and determined their wave-lengths by comparing them with known spark lines in the first order, registered on the same plate[1]. The X-ray line which turned out to be most suitable for such relative measurements was the aluminium $K\alpha_1\alpha_2$ line, which has been determined very accurately by Larsson[2] with a crystal grating From nine different plates I have found the values given in the accompanying table. The value found by Larsson is Al $K\alpha_1\alpha_2 = 8322\ 48$ X U, or, corrected for the refraction in the crystal, 8321 35 X U The difference $\Delta\lambda$ between the measured values and the crystal determination is given in the second column For every value found for the Al $K\alpha_1\alpha_2$ line I have computed the corresponding value for the electronic charge e.

Al $K\alpha_1\alpha_2$	$\Delta\lambda$	e
8 3405 A	+ 2 3 per thousand	4 807 $\times 10^{-10}$ E S U
3406	+ 2 3	807
3399	+ 2 2	806
3410	+ 2 4	808
3373	+ 1 9	802
3406	+ 2 3	807
3393	+ 2 1	805
3397	+ 2 2	806
3423	+ 2 5	811
8 3401	+ 2 25	4 806

As these measurements are based on a direct comparison of X-ray wave-lengths with optical lines of known wave lengths, the values ought to be free from systematic errors The accuracy can be estimated from the different values given in the table The final result is

$$\text{Al } K\alpha_1\alpha_2 = 8\ 340 \pm 0\ 001 \text{ A.}$$
$$1{,}000 \text{ X U} = (1\ 00225 \pm 0\ 0001) \times 10^{-8} \text{ cm.}$$
$$e = (4\ 806 \pm 0\ 003) \times 10^{-10} \text{ E S U}$$

Further details as to the method and the apparatus will be published elsewhere

MARTIN SÖDERMAN

Physics Laboratory,
Uppsala.
Nov 25

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[1] See also Siegbahn and Söderman, NATURE, 129, 21, Jan 2, 1932
[2] Larsson, Diss Uppsala, Univ Årsskr, 1929

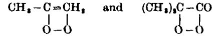
Significance of Proknocks in Hydrocarbon Combustion

OWING to the complicated nature of hydrocarbon molecules with several carbon atoms, it is difficult to obtain precise evidence as to the nature of the chain mechanisms controlling combustion. Further results have been obtained which throw some light on these processes[1]

A large number of substances have a mild proknock effect as can be measured in knock rating tests; a special class of substances, however, have a pronounced effect in concentrations as low as 10^{-5} and 10^{-6} mol fraction. These organic compounds are so constituted that they can disrupt to give radicals as follows :—

$$C_2H_5O{-}\vdots{-}OC_2H_5\ ;\ C_2H_5O{-}\vdots{-}OH\ ;\ AcO{-}\vdots{-}OH,$$

whereas other peroxides, the fissure of which can not take place in this way, show no marked knocking effects; for example —



$$\underset{O-O}{CH_3-C=CH_2} \quad \text{and} \quad \underset{O-O}{(CH_3)_2C-CO}$$

Similarly the knocking characteristics of various nitrogen compounds fit in with this, for organic nitrates and nitrites show this same fissure, Steacie[2] has shown that ethyl nitrite decomposes thus, $C_2H_5O \vdots{-}NO$ These compounds have a pronounced proknock effect of the same order as alkyl peroxides Nitro compounds on the other hand, such as nitromethane and nitrobenzene, possess only a slight proknock effect, because fissure does not occur in this manner

These remarks also bear relation to the observations of Hinshelwood, Williams and Wolfenden[3] who show that chain branching in the combustion of hydrogen is due to a similar type of fissure to that discussed above, namely, $HO{-}\vdots\,OH$ and $DO\,\vdots{-}OD$.

Amongst many apparently conflicting phenomena associated with combustion, it would seem that this disruption of an already oxygenated molecule may be common to many *explosion* processes which depend on chain branching The "centres of high energy from which reaction can spread quicker", to which mention was made in some former investigations[4], become the regions where disruption occurs It is interesting to find that the concentrations required for the proknock effect is smaller than 10^{-5}, since concentrations of antiknock of about the same order are required to prevent it

The significance of these and other facts relating to the effect of various substances on knocking and on ignition will be discussed elsewhere

A R UBBELOHDE,
A. EGERTON

Clarendon Laboratory,
Oxford

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[1] cf Egerton and Ubbelohde, NATURE, 133, 170, Feb 3, 1934
[2] *Proc Roy Soc*, A, 146, 388, 1934 and *J Chem Phys*, 2, 345; 1934
[3] *Proc Roy Soc*, A, 147, 48, 1934
[4] See supplement to NATURE, July 7, 1928

The Thermal Decomposition of Acetaldehyde

NATURE of October 13 and October 27 contain criticisms by Prof M W Travers of work from this laboratory on the thermal decomposition of acetaldehyde. I had already expressed disagreement with similar criticisms at a meeting of the Royal Society in May, and did not wish to enter into a controversy in the columns of NATURE. Lest, however, absence of any comment be interpreted as acceptance, may I be allowed to state quite briefly that fresh experimental work by Dr. Winkler (in process of publication elsewhere) fully confirms that the reaction under the conditions of our previous work is almost entirely homogeneous, and shows by direct chemical analysis that the pressure increase gives a reliable measure of the actual rate of disappearance of acetaldehyde?

C. N. HINSHELWOOD.

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Dec. 15.

Oxidising Agents and Vat-dyed Cotton

In the course of an investigation into the action of oxidising agents upon cotton dyed with vat dyestuffs, we have obtained evidence of a simple relationship between the stable potential set up when a platinum electrode is dipped into a dilute solution of sodium hypochlorite, and the amount of chemical modification produced when this solution acts, under standard conditions, upon pure cotton cellulose dyed with the reduced or leuco form of certain vat dyestuffs These results may prove of interest to those engaged in a study of the chemistry of cellulose and similar polymolecular compounds and also to those who are working on phenomena of oxygen transfer facilitated by a chemically labile substance

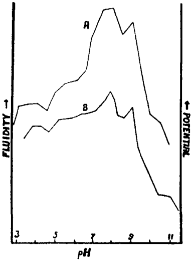

Fig 1.

Certain vat dyestuffs exhibit great resistance to the action of chemical reagents in dilute solution, except that they are readily reduced at the essential quinone groups. The reduction- or leuco-compound is usually unstable, reverting easily to the vat dyestuff on contact with atmospheric oxygen or upon treatment with dilute aqueous solutions of oxidising agents The presence on the cotton fibre of this reduced form of some vat dyestuffs causes a remarkable acceleration in the rate of chemical modification of the cellulose by dilute sodium hypochlorite If this modification is measured by the increase in the fluidity (reciprocal of viscosity) of standard solutions of the treated cellulose in solutions of cuprammonium hydroxide, it can be shown that more modification is accomplished in a few seconds in the presence of reduced dyestuff than is brought about over a period of some hours by hypochlorite acting in the presence of the fully oxidised form of the dyestuff, or in the complete absence of vat dyestuff In all these experiments light is excluded

In a series of experiments, cotton dyed with a reduced vat dyestuff was treated, in the dark, for 10 minutes with dilute sodium hypochlorite solutions, maintained at a number of different hydrogen ion concentrations by a procedure in which the sodium hypochlorite is employed as its own buffering electrolyte. The connexion between the chemical modification of the cellulose (as measured by its fluidity) and the pH of the hypochlorite solution is given in curve *A* on Fig. 1 In curve *B* is shown the connexion between pH of the hypochlorite solution and the potential set up by it at a clean platinum electrode. This potential was measured in the usual way by forming a cell with the platinum electrode and a saturated calomel half element and measuring the E.M F. of the cell potentiometrically The potential at the platinum electrode is expressed by comparison with the hydrogen electrode in a solution of the same pH as the solution under examination

The remarkable agreement between these two curves is not found in the unaccelerated oxidation of cellulose in the absence of reduced vat dyestuff. The agreement appears to indicate (*a*) simple relationship between the cuprammonium fluidity and the mean molecular size of cellulose modified by accelerated hypochlorite oxidation, (*b*) a consistent and uncomplicated mechanism for the oxidation of cellulose by hypochlorite over a considerable range of hydrogen ion concentration, when the oxidation is accelerated by reduced vat dyestuff

The use of reduced vat dyestuffs or analogous accelerating substances may lead to a simplification of the study of the oxidation of cellulose and similar compounds.

A fuller account of this work will appear in a forthcoming issue of the *Journal of the Society of Dyers and Colourists*

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F SCHOLEFIELD

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Nov. 7

Vision in the Ultra-Violet

In a letter in NATURE of November 10 (p. 736) Prof. Fabry mentions two publications by Saidman on this subject, hitherto unknown to me, which I read with great interest. In one of them the correlation of the property of seeing ultra-violet light with

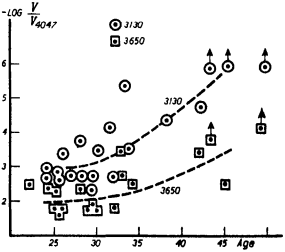

Fig 1 Visibility for λλ3130 and 3650 relative to λ4047 plotted against age The points marked by arrows mean that the value of $-\log (V/V_{4047})$ is certainly larger than indicated.

age is discussed As I measured quantitatively V_{3650}/V_{4047} and V_{3130}/V_{4047}, it seemed to me of some interest to publish a graph (Fig 1) of these quantities against age, which confirms well that there is a general decrease of visibility between thirty and forty-five years of age, as affirmed by Saidman. Indeed, also in my case no one older than forty-three could perceive light of wave-length 3130

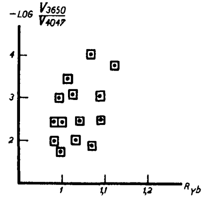

FIG 2 Visibility ratio V_{3650}/V_{4047} plotted against yellow-blue ratio R_{yb} No apparent correlation

The general behaviour of younger and older people was very well confirmed by many tests, which were not worked out quantitatively. I have also tried to plot the quantity V_{3650}/V_{4047} against the yellow-blue ratio. It happened that many of those who underwent the ultra-violet test were measured as to R_{yb} according to Ives (ratio of candle power of specified carbon filament lamp viewed through potassium bichromate and copper sulphate filter) From this graph (Fig. 2), it is seen that this correlation is very poor This emphasises that the question of vision in the ultra-violet is more determined by accidental properties of the eye (colouring of liquids) than by a certain disposition of receptors.

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Nov. 21.

Origin of Variations within Species

IN the salivary glands of the larvæ of *Drosophila*, the chromosomes, which are of immense size, about seventy-five times the length of those in other tissues, show a banded structure. This can be seen in living cells stained with methylene blue and in permanently fixed preparations. The width and spacing of the bands are characteristic and constant for each part of the chromosomes, as was found by Painter[1].

The homologous chromosomes in the salivary glands undergo somatic pairing, hence the number appears to be haploid, each thread actually representing two closely fused chromosomes. This pairing is evidently conditioned by homology in the same way as pachytene pairing. Individuals, heterozygous in respect of the structure of the chromosomes, that is, in the linear arrangement of their genes, show differences of sequence by changes of association.

In *Drosophila pseudo-obscura* there are several geographical lines and races which do not differ in gross morphology, but can be distinguished by the shape and size of the Y chromosomes in the males, and by sterility and other abnormalities in their male hybrids (Koller[2], Dobzhansky[3]) La Grande 2 (weak race A, Dobzhansky and Boche[4]) and Texas 1 (strong race A) are two such races In the salivary glands of the hybrid from the cross between these races, the sex chromosomes pair as in pure races, which indicates complete homology in their internal structure Three out of the four autosomes pair regularly throughout their length, but in the remaining one an intercalary segment of one member pairs in an inverted sense with respect to the segments on either side of it. When pairing is complete, these intercalary segments form a characteristic loop (Fig 1, right) When it is incomplete, either the intercalary segment or one or both of the ends remain unpaired (Fig 1, left). Diagrams of the four possible types of pairing are shown in Fig. 2

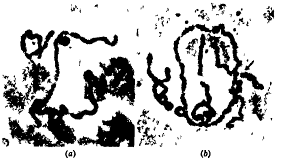

FIG 1 (a) Complete and (b) incomplete pairing of chromosomes in the salivary glands of *Drosophila* carrying inversion.

The cross is therefore a structural hybrid and the two races differ not only in regard to the structure of their Y chromosome but also in regard to the structure of one pair of the autosomes. An inversion of a segment has occurred in the history of one of them since their separation from a common stock.

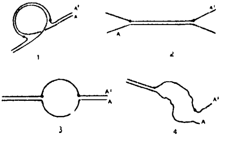

FIG 2 Diagram illustrating the different types of pairing of chromosomes heterozygous for inversion A' indicates the chromosome with an intercalary inverted segment. 1, complete, 2, 3, and 4, incomplete pairing.

Differences in abnormality which occur between males in the crosses involving these races and race B cannot be due to the Y chromosome alone. There must also be differences between the X chromosomes or between the autosomes. In view of these observations, it seems probable that the genetic behaviour is associated with the structural differences found in the autosomes.

Incidentally, it may be noted that it is possible to analyse variations rapidly by cytological technique, which could only be detected by the experimental breeder with considerable difficulty

P CH KOLLER

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Dec 1

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[1] Painter, Th S, "The Morphology of the X-Chromosome in the Salivary Glands of *Drosophila melanogaster* and a new Type of Chromosome Map for this Element", *Genetics*, **10**, 448–469, 1934

[2] Koller, P Ch, "Spermatogenesis in *Drosophila pseudo obscura* Frol II The Cytological Basis of Sterility in Hybrid Males of Races *A* and *B*", *Proc Roy Soc Edin*, **54**, 67–81, 1934

[3] Dobzhansky, Th, "Studies on Hybrid Sterility I Spermatogenesis in Pure and Hybrid *Drosophila pseudo-obscura*", *Z Zellf u mik Anat*, **21**, 169–323, 1934

[4] Dobzhansky, Th, and Boch, R D, "Intersterile Races of *Drosophila pseudo obscura* Frol", *Biol Centr*, **53**, 314–320, 1933

Embryo Sac and Embryo of *Moringa oleifera*, Lamk.

THIS plant was first investigated in 1923 by F L Rutgers[1], who makes some astonishing statements regarding the development of the embryo sac and embryo He states that the archesporial cell is deep-seated in the nucellus, and functions directly as the megaspore mother cell without cutting off any parietal tissue. This on reduction gives rise to a T-shaped tetrad of megaspores of which the lower produces a 5-nucleate embryo sac He further remarks that the fertilised egg undergoes several free nuclear divisions and wall-formation starts only after sixteen nuclei have been formed

As my results are very different from these, I think it worth while to record them briefly

The young nucellus usually shows a single hypodermal archesporial cell This cuts off a primary parietal cell which by further divisions forms three or four wall layers The megaspore mother cell divides in the usual manner to form four megaspores which may either be arranged in a single linear row or in the form of a T

Embryo Sac The nucleus of the functioning megaspore divides three times to form a normal 8 nucleate embryo sac The antipodals are ephemeral, but in some cases they may persist for quite a long period In the former case an older embryo sac would appear to be only 5-nucleate, and it is just possible that Rutgers based his conclusions on the observation of such embryo sacs

In some cases, two embryo sacs were present within the same nucellus, and in one case I saw two paired nucelli each with its separate inner integument, but with a common outer one. Many irregularities exist in connexion with the total number of nuclei in the embryo sac In several cases the egg apparatus was seen to contain four or even five cells. The number of free nuclei in the middle of the embryo sac was found to vary from 2 to 6

Endosperm and Embryo The primary endosperm nucleus divides rapidly forming a mass of nuclei specially crowded at the micropylar end In poorly fixed material some of these nuclei become arranged in such a way that the whole body appears to be a free-nucleate egg A careful study of serial sections reveals, however, that the fertilised egg is situated just above this mass of nuclei and divides much later. The first separating wall is transverse, as in other Angiosperms. The upper cell divides to form a massive suspensor The mature embryo is dicotyledonous, but in some cases it may become tricotyledonous due to a split in one of the cotyledons

I wish to express my sincere thanks to Dr. P Maheshwari for guidance and suggestions throughout the course of this investigation I am also grateful to Prof K Schnarf, of Vienna, who took the trouble of examining some of my slides and confirmed my observations

VISHWAMBHAR PURI

Department of Botany,
Agra College,
Agra Oct 28

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[1] *Ann Jard Bot Buitenzorg* **31** 1–60, 1923

Structure of the Caudal Fin of the Cod

As the cod is a type commonly dissected by students in zoological laboratories, may I point out an error which still occurs even in the latest text-books concerning the structure of the caudal fin of this fish?

Textbooks assert that there is something peculiar about the tail fin of the cod and other Gadidæ, and state that it is symmetrical both externally and internally. It is also stated that the Gadidæ do not pass through a heterocercal stage in development Hence the fin is described as 'isocercal', 'diphycercal' or 'pseudocercal', and in fact this alleged diphycercy has led to conclusions of great importance such as phylogenetic relationship and the composition of the present fin

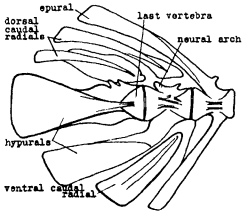

FIG 1 Skeleton of the caudal extremity of the cod

However, I merely invite the attention of teachers of zoology to the accompanying sketch (Fig 1) of the extremity of the caudal fin skeleton of the cod, from which they can draw their own conclusions It can be easily verified by dissection and clearing in xylol. It is scarcely possible to call the fin anything else but homocercal, as in the majority of Teleosts There is clearly nothing peculiar whatever about the structure. Moreover, in *Gadus minutus* at least, and doubtless in every other Gadid, a heterocercal stage is very obvious in specimens one inch long

An exactly similar error appears constantly in regard to the caudal fin of the eel, which is also homocercal For those interested, I venture to direct attention to my previous papers on caudal fin structure in fishes[1]

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London, E.17.
Nov. 19

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[1] "The Caudal Fin of Fishes", *Proc Roy Soc.*, B, **[illegible]**, 1910 "The Caudal Fin of the Teleostomi", *Proc. Zool. Soc*; 1910 "The Caudal Fin of the Eel *Chaudhuria*", *Rec. Ind Mus*, April 1918. "The Evolution of the Caudal Fin of Fishes", *Rec Ind. Mus.*, August 1918.

Estimation of General Ability

IN statistical theory it has been for some time a discipline for statisticians to distinguish by appropriate notation a population parameter that is being estimated and the measure obtained from a sample that is to be its estimate. It is now, for example, common for a true population correlation coefficient to be denoted by ρ, and r to be our sample estimate of it.

In Spearman's theory of ability there are sufficient real difficulties, without the introduction of one or two of a more artificial kind that I venture to comment on here because they seem to me to have arisen mainly owing to the non-recognition of the value of this discipline in the psychological domain. If, as a convenient notation in Spearman's two-factor theory, we denote a person's general ability by G, and our estimate of it by g, we can at once realise certain facts about g that have nevertheless been put forward in rather an obscure way in the literature.

Thus g will not be identical with G, and consequently it may be said that G is indeterminate. A quantity ι has been introduced to represent this indeterminacy. Though, however, we may choose to write a formal equation relating g, G and ι, this will not tell us qualitatively more than we already know, that g in general differs from G. The difference may be regarded statistically as the error of estimation; actually it must be a function of the specific abilities corresponding to the tests used. This has been pointed out recently by Prof. Godfrey Thomson[1].

Further, it has been stated that g is not conserved by linear transformations of the test scores. A transformation in general, since it implies that the same test score will contribute to more than one of the new test scores, will introduce group factors where none might have existed before, and correlations among the new test scores will not therefore satisfy the tetrad criterion; yet we can always regard any new value g', say, obtained from them as an estimate of G. We shall expect g' to differ from g, but this would appear to have little relevance to what value we ascribe to Spearman's theory.

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Jealott's Hill,
Bracknell, Berks.

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[1] *Brit. J. Psychol.*, **25**, 92–99, 1934.

Measuring General Intelligence by Tests which break the *g*-Hierarchy

IN an article in the current number of the *British Journal of Psychology*, I have shown that two tests which fit separately into a hierarchy, but the correlation of which with one another breaks it, can under certain conditions be weighted so as to form a team of two tests correlating perfectly with g. The object of the present note is to point out an extension of this principle. If k tests each fit separately into a hierarchy, but cannot co-exist in it, their correlations with g ($r_{1g}, r_{2g} \ldots r_{kg}$) can be separately found. A team of these k tests can then be formed, with weights proportional to $(-)$ the co-factors of r_{1g}, $r_{2g} \ldots r_{kg}$ in the determinant

$$\Delta = \begin{vmatrix} 1 & r_{1g} & r_{2g} & \cdot & r_{kg} \\ r_{1g} & 1 & r_{12} & \cdot & r_{1k} \\ r_{2g} & r_{12} & 1 & \cdot & r_{2k} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ r_{kg} & r_{1k} & r_{2k} & \cdot & 1 \end{vmatrix},$$

to give an estimate of g, and this estimate will correlate perfectly with g if the value of the above determinant is zero. If the latter is the case, the k non-conforming tests may be represented as containing among them $k-1$ group components in addition to the general component g.

GODFREY H. THOMSON

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Edinburgh.
Nov. 12.

Dipole Moment of Iodine

THE problem of the dipole moment of iodine is of considerable interest. Some years ago, Williams[1] and Muller and Sack[2] measured the moment of iodine in benzene and carbon disulphide solutions and obtained a value of $1\text{–}1{\cdot}2 \times 10^{-18}$ c.g.s. units. It is well known, however, that the iodine molecule should have a symmetrical structure. It is scarcely likely that iodine would react chemically with benzene under the conditions of their experiments. The moment observed was due to some interaction between I_2 and C_6H_6. It seemed strange to us that a moment of the order of magnitude of 1 Debye, that is, a moment characteristic of a molecule of a marked polarity, should arise through the influence of Van der Waals' forces. The discrepancy between the value observed and that to be expected from theoretical considerations can be attributed to the imperfection of the method of measurements.

The authors mentioned above determined the dielectric constant at one temperature and calculated the moment by subtracting the electronic part, obtained from refraction data, from the total polarisation. This method is not sufficiently precise because the atomic polarisation is neglected. We have measured the dielectric constant of solutions (1–6 per cent) of iodine in benzene and carbon disulphide at different temperatures from 15° to 70° in the case of benzene and from 15° to 35° for carbon disulphide by the heterodyne beat method.

Our experiments show that iodine has no dipole moment in benzene or in carbon disulphide. The probable error of our method of investigation is not greater than 0·1 Debye. The electric moment of iodine is, therefore, within the limits of this error, equal to zero.

W. WASSILIEW.
J. SYRKIN.
I. KENEZ.

Laboratory of Electric Properties of Molecules,
Karpow Institute for Physical Chemistry,
Moscow.
Nov. 28.

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[1] *Phys. Z.*, **29**, 204; 1928.
[2] *Phys. Z.*, **31**, 821; 1930.

Designation of Logarithms to Base *e*

IN a short review in NATURE of November 3 (p. 684) it is remarked that "The notation 'ln' for '$\log_e$' will probably be somewhat strange to British readers".

This notation was used by Jahnke and Emde "Funktionentafeln", and even in the first (1909) edition they did not deem it necessary to explain the meaning of 'ln', so that it was presumably familiar on the Continent twenty-five years ago; it is also used by Milne-Thomson and Comrie in their "Standard Four Figure Tables" (1931), but they thought it desirable to explain in a conspicuous position that

> Logarithms to base 10 are denoted throughout by 'log',
> Logarithms to base *e* are denoted throughout by 'ln',

thus confirming your reviewer's opinion that the notation is "somewhat strange" in Great Britain.

It is to be hoped that this use of 'ln' and 'log' in the latter tables, which are bound to be used more and more as their advantages are recognised, will soon familiarise users with this notation, which appears to possess at least two obvious advantages: it reduces the cost of printing by eliminating the subscript $_e$ or $_{10}$, and it reduces the risk of confusion or error if the hurried user does not notice the subscript.

C. R. COSENS

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Cambridge
Nov. 10

Large Telescope Mirrors constructed by Dr. J. Peate

IN the years 1895–98 the Rev. Dr John Peate, of Greenville, Pa., ground and polished a 62 in. diameter telescope mirror for the American University of Washington, D.C. Prior to that time he had made thirteen other reflectors, in the years 1879–95, which are said to have gone to "all parts of the world, including India". The whereabouts of only two of these thirteen mirrors seem to be known, these being at Thiel College, Greenville, and Allegheny College, Meadville, Pa.

I am endeavouring to compile an accurate account of the making of the 62 in. mirror (the largest glass reflector in the world at that time) which was cast in Butler, Pa., in March 1895, and of Peate's activities as a mirror maker generally. May I ask that if any readers of NATURE know the whereabouts of the missing mirrors, and what use has been made of them, they will be so good as to write to me?

F. W. PRESTON

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Butler, Pa., U.S.A.

Points from Foregoing Letters

WHEN the lighter elements are bombarded with slow neutrons, atomic transmutation may occur with release of energy. Dr. J. Chadwick and Mr. M. Goldhaber, by the bombardment of lithium with neutrons from a radon-beryllium source slowed down by passage through paraffin wax, find that helium and triple-weight hydrogen (H^3) are produced, about five million electron volts of energy being released at the same time. Boron gives a similar result, and these elements are therefore indicated as sensitive detectors for slow neutrons.

From the similarity in chemical constitution of certain substances producing cancer and of the female sex hormone, œstrin, it has been inferred that the latter may be able to produce cancer, and some experimental evidence has already been brought to support this view. Prof. J. B. Collip, Dr. H. Selye and Prof. D. L. Thomson now report cancer symptoms in castrated female rats injected with oil-solutions of the sex hormone.

The transformation of radiant energy into 'matter' was deduced theoretically by Dirac, who showed that two units of radiant energy (quanta) may give rise to a pair of positive and negative electrons (having *mass*). Dr. E. J. Williams now calculates the probability of a similar pair being formed from a quantum and an electron within the atom's nucleus (this electron being equivalent to a quantum or photon, from the point of view of an observer approaching it with a velocity nearly that of light).

A discrepancy exists between the charge of the electron computed from the rate of fall of electrified droplets ($4 \cdot 77 \times 10^{-10}$ E.S.U.) and that calculated from the wave-length of X-rays determined by the ruled-grating method ($4 \cdot 80 \times 10^{-10}$ E.S.U.). This would lead to a corresponding difference in the unit used in measuring X-rays, namely, the X-unit ($= 0 \cdot 001$ A. or 10^{-11} cm.). This will have to be increased, according to Mr. M. Söderman, by about 0·2 per cent (or the numerical value of the X-ray wave-lengths correspondingly changed).

Messrs. A. R. Ubbelohde and A. Egerton put forward the view that the presence of organic molecules which, when disrupted, give rise to radicals (HO-, C_2H_5O–, etc.), increases the amount of knocking in the internal combustion engine and plays an important part in many explosive processes.

A fairly close parallelism between the electromotive force of a platinum electrode in solutions of hypochlorite and the action of the latter upon cellulose fibres dyed with a reduced vat dyestuff, is reported by Mr. H. A. Turner, Mr. G. M. Nabar and Prof. F. Scholefield. The extent of the action was determined from the change in fluidity observed when the cellulose fibre was dissolved in cuprammonium hydroxide solution.

The order of arrangement of genes (carriers of hereditary traits) along the chromosome threads may give rise to peculiar loops, when chromosomes coming from unlike parents (heterogeneous as regards structure) are paired. Mr. P. Ch. Koller submits photographs and diagrams of such abnormally paired chromosomes in the cells of the salivary gland of the fruit fly (*Drosophila*). He points out that they can help in the rapid determination of variations within a species.

A description of the development of the embryo in the seeds of *Moringa oleifera* (from which oil of ben, similar to olive oil, is extracted) is given by Mr. Vishwambhar Puri. It differs from that given by F. L. Rutgers in 1923.

Prof. C. Spearman postulates that ability is made up of a factor due to training in the particular field under consideration, and another factor due to intelligence or general ability, *G*. Mr. M. S. Bartlett states that the latter quantity is indeterminate; it differs from the experimentally estimated ability, *g*, by a factor which depends upon the specific abilities corresponding to the tests used in measuring intelligence.

ERRATUM.—The value of the E.M.F. obtainable from xanthine-uric acid, as obtained by Miss Filitti, was given in this column last week as **− 0·113**; it should have been **+ 0·113**.

Research Items

Domestic Fowl in Britain. A collection of antiquities from York made by the late William Hewitt of York when excavations were being carried on in High Ousegate in 1903 was acquired by the Municipal Museum, Hull, and has recently been placed on exhibition in the Mortimer Museum Among the objects in the collection, described with illustrations by Mr T. Sheppard in the *Naturalist* of December, were twenty-one needles, principally of bone and occasionally of ivory, varying from 5⅝ in to 2⅜ in in length Some of the bone needles are curved and possibly were made from the ulnar bone of a hare. There were also fifteen pins of bone or ivory, varying in length from 4½ in to 1¼ in A hollow tube 5¼ in long may be a comb case It has a deep groove cut in the centre, as though it had been used as a holder This, and a smaller tube, are made from a mammal bone. With these objects were two hone-stones or sharpeners, with perforations for hanging, a tine of red deer antler, sawn off and sharpened to a square point and an amber pendant Of the spindle whorls, one of slate is elaborately decorated with concentric rings on the convex side There are two massive jet rings and a terra-cotta mask with a face and head-dress almost Egyptian in style Among the bones of pig, ox, red-deer and horse, were two specimens which are the tibia and femur of the domestic fowl, *Gallus domesticus* In a recent discussion in the *Ibis* on the domestic fowl in Britain in pre-Roman times, Dr P. R Lowe argues, against the previously accepted view, that it was indigenous These two bones from York would appear to confirm his observation

Bird Sociology. So many anecdotes have been circulated about the attentiveness of individual birds to others of their kind in difficulties, that a light on the other side of bird relationships should not be out of place Eric C Kinsey has studied in California the habits of the long-tailed yellow-breasted chat (*Icteria virens longicauda*). He trapped the female of a pair, and on the following day the male appeared with a new mate and immediately started nesting operations within a few feet of the old nest, notwithstanding the fact that his old mate was anxiously calling to him from a trap placed alongside the old nesting site. He appeared to be indifferent to her presence in the immediate neighbourhood and entirely heedless of her difficulty. Indeed, it was found to be a rule for this species that a captured individual, male or female, of a pair, never succeeded in decoying its mate into the same trap Mating seemed to be casual : of another pair, the male was first trapped , two days later the female appeared with a new mate, whereupon she was trapped, and on the following day the same male appeared with a new female (*Condor*, 36, 235 ; 1934). The regardlessness and fickleness of this chat is in marked contrast to the habits of some other passerine birds which are devoted mates.

Indian Leafhoppers or Jassidæ. Dr. H. S. Pruthi has published a second contribution to the above subject (*Mem. Indian Mus.*, 11, No. 2, July 1934) In the present work he describes the genotypes of some of the genera erected by the late Mr. W. L. Distant, and also revises the genus *Moonia*, Dist. Dr. Pruthi remarks that Mr. Distant is the author of more than 60 per cent of the genera and species of the family described from India. Unfortunately, both the descriptions and illustrations of most of the new forms described by this author are very inadequate The need has consequently arisen for a thorough revision and redescription of most of Distant's material in order that progress may be made in the further study of the Indian forms The present work is a contribution towards that end, and Dr Pruthi's careful figures, especially of the male genitalia, together with the insect species portrayed on the accompanying plates, should prove of definite value to students of the family in question. The Indian species of Jassidæ, it might be added, constitute an important component of the Jassid fauna of the world, and these memoirs will interest specialists in this large and rather neglected group of insects.

Results of Nerve Grafting. Sir Charles Ballance has recently published a short monograph ("The Conduct and Fate of the Peripheral Segment of a Divided Nerve in the Cervical Region when united by Suture to the Central Segment of another Divided Nerve" London . Macmillan and Co , Ltd , 1934 7*s* 6*d* net) dealing with his more recent work on nerve grafting He finds that when the cervical sympathetic trunk is made to supply a voluntary muscle, the motor end plates have the normal structure and the sympathetic fibres increase in diameter as the end plate is approached According to Langley and Anderson, it is only the preganglionic fibres of the sympathetic system which can be made to supply voluntary muscle ; the post-ganglionic can never take the place of somatic fibres This distinction agrees with the modern pharmacological grouping of nerve fibres for (in Dale's terminology) the somatic and preganglionic fibres are 'cholinergic' whilst the post-ganglionic fibres are 'adrenergic' There are, it is true, considerable differences both in the structure and speed of reaction of somatic and preganglionic fibres, but Ballance's work shows that after the substitution has been made, the preganglionic fibres retain their characteristic size in the nerve trunk down which they have grown, but become modified in the muscle as they approach their destination in the motor end plate

Elm Disease in Great Britain. A brief memorandum issued by the Forestry Commission gives a review of the seventh annual survey of the extent of the attack of the insidious and at times highly virulent malady of the elm genus. During last summer, the disease is said to have made definite progress in nearly every area examined, but the severity of the attack is below the peak year of 1931. Infected trees have been recorded in three new counties, Lancashire, Merionethshire and Cornwall The classification of the counties of England and Wales shows nine where the attack is frequent and often serious, sixteen where it is sporadic, sixteen seldom found and eleven in which the disease has not yet been reported. It is considered that a more wide-spread survey would almost certainly add to the numbers in the classes 'sporadic' and 'seldom found' The nine counties where the pest is worst all lie to the north and east of London, save the Isle of Wight. It is said that there is no indication as yet of the disease extending westwards. The point of interest which is being studied is what proportion of attacked trees recover partially, but still remain in a condition where the infestation may restart; and what proportion recover entirely. In a case in Kent, known to the writer, three young vigorously growing trees, two standing within ten yards of one another, the third a hundred yards away, were attacked some four or five years ago. Of the two standing close together the first attacked appeared to have recovered and then died within a year. The second has entirely recovered. The third tree lost its leader, then died rapidly from the top, and was then felled and burnt. The fungus had penetrated into some of the branches half way down the stem. The elm bark beetle is said to be a chief carrier of the disease. No beetles or their galleries were found in any of the three trees. No definite record of the elm disease has yet been reported from Scotland.

Specific Heats of Gases at High Temperatures. G. G. Sherratt and Ezer Griffiths, working at the National Physical Laboratory, have measured the specific heat of carbon monoxide at temperatures of the order 2,000° C., using the velocity of sound measured in a graphite tube (*Proc. Roy. Soc.*, Nov. 15, 1934). Previous attempts to measure the specific heats of gases at high temperatures have been made by the explosion method, involving great experimental difficulties and large uncertain corrections. The train of sound waves was set up by a quartz piezo-electric crystal, the effective length of the tube was varied by moving a carbon piston, and the condition of resonance was indicated by changes in the plate current of the oscillator maintaining the vibration of the quartz crystal. Temperatures were measured by a disappearing filament pyrometer. Since the velocity of sound in a gas shows a dispersion effect, being different for different frequencies, the velocity was measured at several frequencies and a correction applied, using a theoretical result of Kneser. The specific heat finally deduced was in good agreement with that deduced from band spectroscopic data.

Molecular Clustering in Fluids. R. S. Krishnan (*Proc. Indian Acad. Sci.*, Oct. 1934) has made optical experiments to test for the presence of molecular aggregates in liquids and liquid mixtures. A beam of polarised light was passed through the liquid, and the 'depolarisation' (that is, the ratio of the intensity of the horizontal to the vertical components of polarisation) of the light scattered at right angles is observed. If the scattering particles are comparable in size with the wave length of light, this depolarisation may be observed. Negative results were obtained with a number of organic liquids. Positive results were obtained with a binary liquid mixture (carbon disulphide + methyl alcohol) and this effect persisted at temperatures lying within a considerable range around the critical solution temperature.

Exploration of the Upper Atmosphere by Self-Recording Balloons. E. Regener and his co-workers (*Phys. Z.*, Oct. 1, 1934) have obtained further information on cosmic rays and on the absorption of light in the atmosphere by the use of beautiful self-recording instruments carried by sounding balloons. E. Regener and G. Pfotzer sent up a Geiger-Müller counter, which with its high-tension battery and counting mechanism gave a load for the balloon of about 6 kgm. The apparatus attained a height of 28 km. and the impulses counted gave a variation with height practically identical with that formerly observed with ionisation chambers. The readings at the highest altitudes show a transition effect due to the formation of secondary radiations as the radiation enters the atmosphere. Measurements were made by E. Regener and R. Auer with a large, open ionisation chamber connected to a self-recording electrometer, the chamber being in some experiments lined with paraffin or celluloid. The experiments showed that no large part of the cosmic ray intensity was due to neutrons. E. Regener and V. H. Regener sent a quartz spectrograph to a height of 30 km. with a balloon. In order to avoid setting the spectrograph to point at the sun, the slit was directed towards a white disc illuminated by the sunlight. The camera took a number of spectrograms on a rotating plate, the height being indicated on each by the shadow of an aneroid pointer. The plates were measured in a photometer at two different wave lengths lying in the region where the absorption of ozone sets steeply in, and the results used to obtain the distribution of ozone in the atmosphere. The maximum concentration of ozone appears to lie in the region 24 km. high, and at 30 km. height 70 per cent of the ozone lies below the apparatus. This result agrees with the estimates of Goetz, Meetham and Dobson, rather than with the earlier view that an ozone layer existed at 40–50 km. height.

Activity Coefficients of Sulphuric Acid. Most of the measurements of the activity coefficients of sulphuric acid have been made with the Hg/Hg_2SO_4 type of electrode. The solubility of mercurous sulphate, however, prohibits its use in acid concentrations below 0·005 molal. The cell containing two-phase lead amalgam, with lead sulphate as depolariser, is free from this objection and has been used by J. Shrawder and I. A. Cowperthwaite (*J. Amer. Chem. Soc.*, **56**, 2340; 1934) in measurements of the activity coefficients of sulphuric acid from 0° to 50° over the concentration range 0·02 to 0·001 *m*. The calculations are somewhat difficult, since the degree of ionisation of the acid, involving the two ions HSO_4' and SO_4'', has to be taken into account, and some assumptions are required. The results at 25° are compared with the La Mer, Gronwall and Greiff extension of the Debye-Hückel theory on the assumption of an ionic size of 1·75 A. The results are also applied to the calculation of the heats of dilution of sulphuric acid. The results are widely divergent from those obtained by the calorimetric method, particularly at low concentrations. When plotted against the square root of the molality, the calorimetric heats of dilution provide a curve which becomes linear below 0·001 *m*. The electro chemical values indicate a curve which exhibits a point of inflexion such as would be required to bring the curve into the limiting Debye-Hückel slope. A large part of the difference is shown to be due to the different methods of extrapolation used, and adequate agreement is obtained above 0·0036 *m*. The calorimetric data are, however, shown to be in disagreement with several independent results of electromotive force measurements, so that there is at present a real discrepancy between the values of the heat of dilution determined by the two methods which is not explained.

Experimental Work on Cancer

IN the recently issued annual report of the Imperial Cancer Research Fund[1], Dr J A Murray records the main properties of twenty-eight different strains of animal tumours which are maintained in the laboratories of the Imperial Cancer Research Fund He appeals to other institutes to publish similar "statements of the significant characteristics of the tumour strains maintained by them so that investigators throughout the world may more easily compare their material and results".

Rous and Murphy showed that fowl tumours transmissible by cell-free material retain their individual properties, in appearance, rate of growth and distribution of secondary tumours In the first paper of the scientific report[2], Dr Foulds describes such characteristics for six different chicken tumours, and concludes that the behaviour of these tumours is parallel to that of metastases in human cancer In a supplement to the report[3], Dr Foulds gives a detailed summary of the work on the properties of the filtrates which produce tumours in fowls and on the characteristics of such growths The specificity of the malignant tissue produced by filterable agents and the multiplication of such agents with the growth of the tumour differentiates them from the chemical carcinogenic agents. On the other hand, the 'organisers' induce embryonic structures, the growth of which then appears to increase the amount of organiser.

The fourth and fifth papers of the report deal with investigations carried out by Dr A F Watson on the effect of liver diet on tar cancer Maisin showed that when either fresh or cooked liver was fed to mice, they became more susceptible to painting with carcinogenic tar Watson has shown that a preparation of hog's stomach containing the hæmopoietic factor did not have the same effect as liver The results of liver feeding show that the mortality of the control mice is much higher than that of the liver-fed animals, this effect seems to be greater than the influence on tumour production

Dr E S Horning has developed a technique by means of which the distribution of inorganic matter in tissues can be studied. The fixed and sectioned tissue is heated to 650° C, after which the distribution of the ash can be seen by means of dark-ground illumination From this, the form and character of the original cells can be seen. Hypertrophied stroma and most malignant cells appear to contain more inorganic matter than normal cells; in this respect, however, tar tumours seem to differ from other tumours. The method has shown that radium treatment causes redistribution of the inorganic matter, changes are shown within six hours of irradiation and continue for six days There seems no doubt that micro-incineration is a valuable histological and chemical method

Mr H G Crabtree and Dr W Cramer show that treatment of transplantable tumour tissue with the maximum concentration of poisons producing reversible inhibition of the respiration will also allow the tissue to grow when implanted in a host If the poison is used in a higher concentration, the tissue will not grow on transplanting They also show that the physiological environment affects the susceptibility to radium, in general, lowered respiration causes increased susceptibility Dr Cramer has been able to demonstrate that the differences in sensitivity to radium of spontaneous mammary carcinomata in mice are partly due to variations in the extent of macrophage invasion He points out that effective radiation need not kill all the cells directly, but only cause temporary but specific damage.

The last two papers of the report are by Dr R J Ludford and deal with the structure and behaviour of cells in tissue cultures of tumours Macrophages, polyblasts, lymphocytes, giant cells, fibroblasts and malignant cells, all of which occur in such cultures, are described Apart from their morphology, the cells can be differentiated by their movements and reactions to vital stains Careful subculture has given almost pure cultures of malignant cells Ludford has been able to use colloidal solutions of fat-soluble dyes as a vital stain for the fatty parts of cells All cells are stained by such dyes, but as malignant cells are not stained by the water-soluble trypan blue, it is suggested that the plasma membrane of malignant cells is relatively rich in fatty substances. In this respect, the membrane resembles that of the tubercle bacillus.

Many of the papers are fully and beautifully illustrated, and the descriptions immediately below the plates themselves are a great help to the reader

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[1] Thirty second Annual Report (1933-1934) of the Imperial Cancer Research Fund

[2] Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund Pp ix+177+58 plates (London Taylor and Francis, 1934) 30s

[3] Supplement to the Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund The Filterable Tumours of Fowls a Critical Review Pp ii+42 (London Taylor and Francis, 1934) n p

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Annual Meeting of the Science Masters Association

THE thirty-fifth annual meeting of the Science Masters Association was held on January 1–4 at Oxford under the presidency of Prof. N. V. Sidgwick Some three hundred members were present, a number slightly less than the usual number for an Oxford meeting, although the membership of the Association has risen to within the region of two thousand

A full programme of lectures, visits and demonstrations was arranged, together with the usual exhibits by manufacturers and publishers. Various departments of the University were open for inspection and special demonstrations were staged, particularly in the Astronomical, Biochemical, Botanical, Electrical and Chemical Departments

The presidential address, under the title of "Real Molecules", was a lucid account of the modern physical conceptions of atoms and molecules developed as the result of the applications of the ideas of wave mechanics, which, in the opinion of Prof Sidgwick, affect only to a slight degree the dimensions of atoms and their orbits as deduced from the classical theory, but give a much clearer conception of the mechanism of covalency. By assigning to every nucleus a sphere of influence, the dimensions of which can be ascertained by X-ray methods and spectroscopy, and by defining the size of an atom as that portion of space into which other atoms cannot enter, it is possible to avoid the difficulty created by wave mechanics of a cloud of electrons of indefinite size surrounding the nucleus. Using this conception of the size of atoms, combined with a knowledge of the angles between the valencies, a molecular model can be built up This model, however, has a volume much less than the molecular volume obtained in other ways Hence it becomes necessary to assume the existence of an envelope (due to the electrostatic repulsion of the electrons of different atoms within the molecule) surrounding an atom in combination, the thickness of the envelope being dependent on the various types of linkage The effects of molecular collisions on molecular change were also discussed, with particular reference to the possibilities of twisting component parts of the molecules round the valency bonds, the compression and rarefaction of the bonds, and the alteration of their angular values

Mr C N Hinshelwood gave a lecture on "Some Aspects of Modern Physical Chemistry", discussing the significance to chemistry of quantum mechanics, which, he said, has added new laws and methods of calculation in physical chemistry without disturbing existing laws to any great extent Zero point energy, chain reactions, structure of liquids, and heavy hydrogen were topics included in this survey

An evening lecture was given by Prof H H Plaskett on the "Physics of Astronomical Vacua", with special reference to the density and source of luminosity of gaseous nebulæ The lecture was followed by an inspection of the University Observatory "The New Aspect of the Elementary Theory of Organic Chemistry" was taken by Prof R. Robinson as the subject of another evening lecture, in which, using the conception of anionoid and cationoid reagents, he showed how the electron theory is resulting in a unification of physics and organic chemistry Other lectures were "Plant Respiration" by Dr W O James, "Ionisation by Collision" by Prof J S E Townsend, "Tissue Respiration" by Mr R B Fisher All these lectures were much appreciated by members of the Association, for whom much of the value of these annual meetings lies in the lucid résumés of modern work by experts in their various subjects.

A lecture-demonstration which attracted much attention was given by Dr K J Franklin on "X ray Cinematography" This was illustrated by films of the circulation of the blood and respiratory movements of various mammals

Sound film demonstrations formed a large and interesting part of the general programme of the annual meeting Three films were shown, suggested as suitable films for class science teaching by the British Film Institute, on which body the Science Masters Association has representatives The films were "The Molecular Theory of Matter", "Sound and its Production", and "The Cathode Ray Oscillograph" While all these films did not find favour in every particular (indeed humour was provoked in unexpected places), it was realised that here is a valuable addition to teaching technique, particularly as a method of revision Difficulties in the matter of cost, standard projectors, silent versus talking films, were raised and discussed at the demonstrations

At the business meeting, the following elections took place *President*, Sir William Bragg , *Secretary*, S V Brown (Liverpool Institute) ; *Annual Meeting Secretary*, R E Williams (Repton) , *New Committee Members*, Dr W G Davis (Newcastle Grammar School), L G Smith (Marylebone Grammar School), F R Snell (Eastbourne College). Changes were made in the rules to permit of the election of honorary members, and all past presidents were elected to that dignity. The annual report showed that the Association has now 1921 members representing 797 schools, an increase in the year of 109 members and 40 schools The branch organisation of the Association is proceeding apace The North Eastern, South Wales and North Western branches have been in existence for several years. Other branches in Yorkshire, East Anglia and possibly Middlesex are in process of formation This branch organisation, it is realised, is likely to involve difficulties of representation

The annual meeting for 1936 will be held in London under the presidency of Sir William Bragg

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Periodic Variations in the Mean Focal Depth of Japanese Earthquakes

By Dr. Charles Davison

DURING the last ten years, many estimates have been made of the focal depths of earthquakes in Japan They depend on the duration of the preliminary tremors at three or more neighbouring stations Two lists have been published, one by Mr. N. Nasu of the after-shocks of the Tango earthquake of March 7, 1927 (*Earthq. Res Inst Bull* , 6, 245–331 ; 7, 133–152 ; 1929), the other of ordinary earthquakes felt in Tokyo from 1924 onwards, now issued quarterly by the Earthquake Research Institute

After-Shocks of the Tango Earthquake of 1927 — Mr. Nasu has determined the position of the epicentre and the depth of the focus of 482 shocks from March 11, 1927, to July 16, 1928. The values obtained for the depths range from 0 to 44 km , the mean of all being 15 4 km. or, excluding zero estimates, 15 9 km. The after-shocks are subject to several well-marked periods—of one day, 29 6, 14 8 and 7 4 days, and 42 minutes.

From March 14 to August 31, the focal depths of 438 after-shocks are given The maximum epoch of the diurnal period in the frequency of these shocks occurs at 3 a m., the amplitude of the period being 0 24 During the same interval, the mean depth of the foci was 14 9 km , and the mean depth during successive hours is also subject to a diurnal period with its maximum at 3 a m. and its amplitude 0 03, that is, the oscillations in mean depth due to this period range within about 0 45 km of the mean

The lunar periods are more clearly marked During the 16 lunations from April 2, 1927, to July 17, 1928, the depths of 247 foci were estimated, the mean of all being 16 7 km For both frequency and mean depth, the maximum epoch of the 29 6 day period falls not far from the time of full moon, the amplitudes being 0 37 and 0 09 ; the epochs of the 14 8 day period fall close to the times of first and last quarters, with amplitudes of 0 39 and 0 09, and those of the 7·4 day period about the times of the four principal phases, with amplitudes of 0·16 and 0·11. The ranges about the mean depth for the three periods are, respectively, 1·50, 1·50 and 1·84 km.

The 42-minute period affects both the frequency and the mean focal depth of the Tango after-shocks until the end of May. During March and April, the minima of the periods for both frequency and depth coincided approximately with the return movements from the antipodes of the focus, the amplitudes being 0·25 and 0·06 in March and 0·33 and 0·10 in April, while, in May, the maxima coincided closely with those returns, with amplitudes of 0·54 and 0·13. The ranges about the mean depth during the three months are, respectively, 0·97, 1·64 and 1·91 km.

Ordinary Earthquakes felt in Tokyo.—The lists of such earthquakes, with their estimated focal depths, are given from 1924 to 1933. In the results that follow the earthquakes for the year 1924 are omitted on account of the unusually large number felt in January of that year. Of 564 shocks felt during the remaining nine years, the focal depths of 388 are determined. The variations in mean depth show periods of one year, one day, and 14·8 and 7·4 days.

The maximum epoch of the annual period in the frequency of the earthquakes occurs at about the end of March, the amplitude being 0·11. The mean focal depth of the earthquakes is 46·7 km., and the maximum epoch of the variations in monthly mean depth occurs in the middle of March, the amplitude being 0·08, that is, the range on either side of the mean is 3·7 km.

The diurnal period in the variation of mean focal depth is less pronounced. For the same earthquakes, the maximum epoch of the variation in frequency occurs at 2 a.m., the amplitude being 0·28. The maximum epoch for the mean focal depth occurs at about 11 p.m., the amplitude being 0·05, that is, the range of variations about the mean is 2·3 km.

For the lunar periods, the number of earthquakes of known focal depth from January 25, 1925, to December 17, 1933, is 372. For both frequency and depth, the maximum epochs of the 14·8 day period fall near the times of new and full moon, the amplitudes being 0·16 and 0·03, and the range on either side of the mean depth 1·4 km. The epochs of the 7·4 day period fall near the times of the four principal phases, the amplitudes being 0·14 and 0·04, and the range on either side of the mean depth 1·9 km.

University and Educational Intelligence

CAMBRIDGE.—The Adam Smith Prize offered annually for an essay on some unsettled question in economic science or in some branch of economic history or statistics subsequent to the year 1800 selected by the candidate himself has been awarded to Mr. W. B. Reddaway, of Oundle and King's College, who was placed alone in Division I, Class I, in Part II of the Economics Tripos last June. The prize is valued at £40.

The governing body of Emmanuel College invites applications for a research studentship which will be awarded in July 1935. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150, and is awarded and normally held for two years. The studentship is not open to a woman or to a graduate of the University. Further information can be obtained from the Master, Emmanuel College, Cambridge.

ST. ANDREWS.—R. A. Smith has been appointed Carnegie teaching fellow and assistant in applied mathematics in the United College, St. Andrews, in succession to Dr. D. E. Rutherford, who has been promoted to the post of lecturer in mathematics and applied mathematics.

PROF. F. E. WEISS, formerly Harrison professor of botany in the University of Manchester, has been appointed to take charge of the botanical department of the Egyptian University at Abbassia, Cairo, from February 1 until the end of May, in succession to Prof. F. W. Oliver, who is retiring from the professorship.

Science News a Century Ago

Faraday's Eyesight

Faraday's "Diary" is strictly a laboratory record of experiments, and from end to end there are very few references in it to matters outside his experimental work. One of these personal entries occurs on January 15, 1835.

"Within the last week have observed twice that a slight obscurity of the sight of my left eye has happened. It occurred in reading the letters of a book, held about 14 inches from the eye, being obscured as by a fog over a space about half an inch in diameter. This space was a little to the right and below the axis of the eye. Looking for the effect now and other times, I cannot perceive it. I note this down that I may hereafter trace the progress of the effect if it increases or becomes more common."

It does not seem that the obscurity occurred at all frequently, for no further reference to it in the "Diary" has been traced. None of Faraday's biographers makes any reference to defective eyesight. The thick glass spectacles used by him, which are preserved at the Royal Institution, were worn only to protect his eyes from the effects of explosions during the experiments on the liquefaction of gases. Among the numerous portraits of him one photograph has been found, taken probably after 1860, in which he is holding a pair of spectacles in his hand; and it would appear that he used glasses for reading in his later years; but apart from this, it is evident that he retained his sight practically unimpaired to the end.

Geographical Exploration

On January 15, 1835, *The Times* said: "A lecture interesting both to the friends of science and the friends of commerce was last night delivered at the London University by Captain Maconochie. The lecturer commenced by saying two expeditions of discovery were now being sent out by the efforts of the Royal Geographical Society. One of these expeditions was to explore the interior of Southern Africa and the other to explore the regions to the south and south-west of British Guiana. The Geographical Society had done much to further discovery and their exertions had been most beneficial to the promotion of geographical science." Referring to the expedition to Africa, Capt. Maconochie said: "The continent of Africa had already been penetrated 1,400 miles from the Cape of Good Hope. The countries further north were found to be the furthest advanced in the arts of civilised life. At the distance of 1,400 miles from the Cape the arts of smelting iron and copper, and of carving in ivory were known Commerce had penetrated in that direction nearly 1,400 miles, and a trade to the amount of 1,600£ had been carried on in one expedition Captain Alexander had volunteered to explore these regions. He had sailed from England in September last " As regards the expedition in British Guiana "The French nation had sent out two gentlemen for the purpose of making discoveries, and from the funds of the Geographical Society 500£ had been given towards sending out from this country a gentleman for the same purpose The Government of the country had contributed 1,000£ to forward his exertions in so laudable an enterprise "

The Eastern Counties Railway

By 1835, plans for railways to connect London with the north, south, west and east of England were being prepared, and on January 17, 1835, the *Mechanics' Magazine* said that the "Eastern Counties Railway which is to run from London to Yarmouth, by way of Chelmsford, Colchester, Ipswich and Norwich will be one of the most level, for its length, yet laid down in the whole kingdom According to the report of the engineers, there will be nowhere a greater rise than 1 in 400 , no embankment of more than 28 feet high , and not a single tunnel throughout its whole length The average cost per mile will, in consequence of these singularly favourable circumstances, be less than any other railway constructed, or in progress of construction, in Great Britain The estimates of revenue are also extremely encouraging From there being no canal communication between the metropolis and the counties of Essex, Suffolk and Norfolk, there is a greater waggon traffic on this line than on any other in the kingdom The passenger traffic is also so considerable, that it would of itself suffice to pay all the expenses of the railway, and leave a handsome profit to the proprietary "

Volcanoes of South America

On January 18, 1835, for the second time, H M S *Beagle* anchored in the bay of San Carlos in Chiloe "On the night of the 19th," wrote Darwin, "the volcano of Osorno was in action At midnight the sentry observed something like a large star, which gradually increased in size till about three o'clock, when it presented a very magnificent spectacle I was surprised at hearing afterwards that Aconcagua in Chile, 480 miles northwards, was in action on this same night , and still more surprised to hear that the great eruption of Coseguina (2,700 miles north of Aconcagua), accompanied by an earthquake felt over a 1,000 miles, also occurred within six hours of this same time This coincidence is the more remarkable, as Coseguina had been dormant for twenty six years ; and Aconcagua most rarely shows any signs of action It is difficult even to conjecture, whether this coincidence was accidental, or shows some subterranean connection. If Vesuvius, Etna, and Hecla in Iceland (all three relatively nearer each other than the corresponding points in South America) suddenly burst forth in eruption on the same night, the coincidence would be thought remarkable , but it is far more remarkable in this case, where the three vents fall on the same great mountain-chain, and where the vast plains along the entire eastern coast, and the upraised recent shells along more than 2,000 miles on the western coast, show in how equable and connected a manner the elevatory forces have acted "

Societies and Academies

DUBLIN

Royal Dublin Society, November 27 E J SHEEHY . A crate for the collection of fæces and urine adjustable for metabolism experiments (solid and liquid) with pigs, sheep and cattle of various sizes J HARDIMAN, J KEANE and T J NOLAN The chemical constituents of lichens found in Ireland *Lecanora gangaleoides* (1) This lichen contains, besides chlor-atranorin, a chlorinated depsidone of constitution $C_{16}H_8O_5Cl_2(OCH_3)_2$ closely allied in structure to diploicin, $C_{15}H_7O_4Cl_4(OCH_3)$, previously found in the lichen *Buellia canescens* H H POOLE and W R G ATKINS The measurement of the current generated by rectifier photo-cells A modification of the method recently described by Campbell and Freeth has proved very suitable for photometric measurements over a very wide range of illumination, and is especially adaptable to marine work (see NATURE, Nov 24, p 810) THOMAS DILLON and TADHG O'TUAMA . The cellulose of marine algæ. Cellulose was obtained from species of *Laminaria* (1) by successive extraction with ammonia and with caustic soda and (2) by a process of retting followed by extraction with soda The methyl and acetyl derivatives and the thiocarbonate of this cellulose resembled in properties the corresponding derivatives of the cellulose obtained from land plants When the cellulose was hydrolysed with sulphuric acid, glucose was obtained, which was identified by the osazone Failure to obtain glucose from algic cellulose reported by other authors may have been due to the impurity of the cellulose, which in the plant appears to be closely associated with a substance corresponding to the lignin of land plants VINCENT BARRY and THOMAS DILLON Preparation and properties of alginic acid and the extraction of marine algæ with various solvents High viscosity has always been regarded as the most characteristic property of solutions of the alkali alginates It has now been found that, if the fronds of *Laminaria digitata* are extracted with boiling water and then with ammonia, the ammoniacal solution which contains the alginic acid is not highly viscous, and filters easily Extraction with a series of solvents in the order mentioned gave approximately the following extracts expressed in percentages of the dry plant : water 40, industrial alcohol 10, industrial alcohol containing a little hydrochloric acid 2, ammonia 20, boiling caustic soda 20, residue of cellulose 8.

PARIS

Academy of Sciences, December 10 (*C R* , **199**, 1345–1463) The president announced the death of Adrien de Gerlache de Gomery, *Correspondant* for the Section of Geography and Navigation MARCEL BRILLOUIN . The Planck quanta and the field of atomic force. A development of the hypothesis that Planck's constant should appear as a fundamental constant of the atomic field which governs the motions of the electrons and the mutual actions of the atoms CHARLES NICOLLE and MME HÉLÈNE SPARROW · Some experiments on the virus of the river fever of Japan (*Tsutsugamushi*). This belongs to the class of exanthematic fevers and is distinct from typhus It is propagated by animal parasites, ticks The rat acts as a carrier for the disease. In this animal there is no fever, and the disease is clinically unrecognisable H. Devaux The action of carbon dioxide on the extension of egg albumen on the surface of water and the variations of the thickness of its films in monomolecular layers Robert Lespieau was elected a member of the Section of Chemistry in succession to the late C Matignon Henri Eyraud A new representation of continuous correlations Georges Darmois The theory of two Spearman factors Paul Delens Congruences of curves in affine varieties Pierre Bergeot The convergence of the developments in series of Legendre polynomials of functions with limited variation. Jules Schauder Linear equations of the elliptic type with continued coefficients Tullio Viola The trend of curves on which holomorph functions of a uniformly converging suite take the same values as the limit function on a given curve V. Ganapathy Iyer A problem of Carleman G Delanghe The study of the balancing of machines with pistons by means of symmetrical rotating vectors Georges Maneff The displacement of the perihelion of Mercury The author's calculations lead to the same figure as those of Le Verrier and Grossmann (solution *B*) J. Ellsworth · The mass luminosity relation and double stars with eclipses Louis Longchambon The mechanical properties of glasses The method used is based on a study of the effects caused by the fall of a steel ball through different heights on to a plane horizontal sheet of glass Ernst Baumgardt A new optical method for the study of the absorption of ultra sound waves by liquids The method is based on the theoretical interpretation of diffraction phenomena proposed by R. Lucas and P. Biquard Edmond Rouelle The influence of the initial charge of the condenser on the transitory phenomena obtained on closing a ferro-resonant circuit P Bernard · The reversibility of piezoelectric phenomena The results given show, in the case of variations of the order of 0 001 second and for pressures on the quartz up to 289 kgm /cm.^{2}, the reversibility on compression and decompression of the charges developed in the quartz Theodore Ionescu and Constantin Mihul The propagation of electric waves · the explanation of echoes Pierre Bricout . The calculation of the perturbation of a hydrogenoid atom by a free electron Georges Liandrat The use of boundary type selenium photo-elements for the measurement and registration of very intense illuminations G Lejeune : The mode of action of controllers in scouring. Study of the effect of the addition of gelatine to acid solutions used for the removal of scale from iron. M Haïssinsky . The applicability of Nernst's electrochemical law to extremely dilute solutions A study of the critical potentials of the cathode deposit of very dilute solutions of bismuth nitrate using the isotopes radium E and thorium C as radioactive indicators A Hautot The structure of the *K* line of beryllium and conductivity electrons. Paul Gaubert : The anisotropy and structure of window glasses Wenli Yeh : Radioactivity induced by neutrons

(*To be continued*)

Cracow

Polish Academy of Science and Letters, November 5. B Kamienski : Electric tensions of solutions of alkaloids, physiological agents Mlle. R. Ludwiczak and J. Suszko : Studies on the relation between the rotatory power and atomic spatial dispersions in the molecules of the cinchona alkaloids J. Fiedzuszko and J. Suszko Spacial transformations of the cinchona alkaloids into epimer bases T Giza Studies on casein Mlle M Brem The distinction between the wood of spruce and larch by the anatomical method A Bursa *Hydrurus fœtidus* in the Polish Tatra J. Zacwilichowski The nerve elements of the haltere and the homology of the haltere and of the wing in *Tipula paludosa*

Prague

Czech Academy of Sciences and Arts, January 12, 1934 B Němec Heterophyly and heterotropy of ivy (*Hedera helix*) F A Novák *Pinus pindica* and *Pinus magellensis* Jar Petrbok *Corbicula fluminalis*, Muller, and the fauna of the Třebestovice pleistocene terrace in Čílce near Nymburk (paleontological part) V. Smetana *Corbicula fluminalis*, Müller, and fauna of the Třebestovice pleistocene terrace in Čílce near Nymburk (geological part) Jar Klika Plant societies on the travertine of Stankovany and their succession

March 2 B Němec Wood from the peat-bog at Františkovy Lázně J Matiegka and J Malý The physique of Albrecht of Valdštejn, Duke of Frýdland. Jan Wolf Polarity of the covering of cartilaginous cells Ot Pankraz The unification method of actuarial science.

April 13 Frant. Patočka Experimental study of the pathogenic possibilities of microbes such as bacillus anthracis. K Hrubý Contribution to the cytology and embryology of *Erythronium* F Toul Catalysis of the polymerisation of acetylene by ultraviolet radiation from mercury vapour R. Koštál : Oscillations of conjugated undamped torsion pendulums Jar. Petrbok Molluscs of the Slovakian quaternian

May 4 J Komárek The luminescence of the Carpathian rain-worm and its cause K. Dusl Stability of the solution of Mathieu's differential equation. K Hrubý and V. Gotthard . Biometry of the needles and cones of *Larix decidua*, Mill , *L sudetica*, Dom , and *L polonica*, Racib J H Křepelka and J Chmelař · Phosphorus poisoning and its detection by the Dusart-Blondlot test

June 15. F Němejc · Some critical remarks on the Sternberg *Lepidodendron dichotomum*. V Rypáček : Contribution to the ecology of the Cladonia family F. Kratochvíl : Prehnites from the vicinity of Čáslav. J Jelínek Contribution to the question of the differentiation in the granite massif of Central Bohemia A Klečka and V. Vukolov Contribution to the question of the mycorrhiza of grass and other meadow plants and its physiological significance. E. Votoček and S Malachta · *A new transition from the sugar series to the furane series.* F Valentin : Anhydromannose, a new sugar anhydride. R. Řetovský · Uranyl nitrate and the energy of germination of old seeds of barley

October 19. V Jirásek Distribution of members of the *Poa*, L. family in the Czechoslovakian Republic R. Pexiedrová : *Projection of the accessory nasal* cavities on the medial wall of the eye R. Lukáč Chemical and physical properties of some tremolites from the vicinity of Tábor and their genetic relations to the mother rock. Fr. Vyčichlo Linear straight-line complex as a three-dimensional variant.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, January 13

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 -- Dr Susan Finnegan "Scorpions" *

Monday, January 14

VICTORIA INSTITUTE, at 4 30 - Sir Ambrose Fleming "Modern Anthropology *versus* Bible Statements on Human Origin"

ROYAL GEOGRAPHICAL SOCIETY, at 5 - Dr H C Darby "The Domesday Geography of Norfolk and Suffolk"

UNIVERSITY OF GLASGOW, at 8 30 Sir John Stirling-Maxwell "National Progress in Forestry" *

Tuesday, January 15

BRITISH INSTITUTE OF PHILOSOPHY--(at University Hall, 14 Gordon Square, London, W C 1)--Prof H Levy "Science and Philosophy in Nature" *

Wednesday, January 16

ROYAL MICROSCOPICAL SOCIETY, at 5 30 —Prof W A F Balfour-Browne "Species Characteristics" (Presidential Address)

ROYAL METEOROLOGICAL SOCIETY, at 7 30 —Annual General Meeting

Lieut Col E Gold "Fronts and Occlusions" (Presidential Address)

ROYAL ENTOMOLOGICAL SOCIETY, at 8 —Annual Meeting Dr S A Neave "The Development of Bibliographical Work relating to Entomology" (Presidential Address)

ENGINEERS' STUDY GROUP ON ECONOMICS, at 8 --Maj Attlee "The Engineer's Place in the Socialist State" *

Thursday, January 17

BEDFORD COLLEGE FOR WOMEN, at 5 15 Prof F C. Bartlett "Time from the Point of View of the Psychologist" *

Friday, January 18

ROYAL INSTITUTION, at 9 —Sir William Bragg "The Theoretical Strength of Materials and their Practical Weakness"

Official Publications Received

GREAT BRITAIN AND IRELAND

Bibliography of the More Important Metals occurring in Food and Biological Material (for the Years 1921 to 1933 inclusive) Compiled for the Society of Public Analysts and other Analytical Chemists Pp 80 (London The *Analyst*) To Members, 2*s* , to non-Members, 3*s*.

University College of North Wales Calendar for Session 1934-35 Pp 442 (Bangor)

The National Institute of Poultry Husbandry Bulletin No 10 Table Poultry Production By A J Macdonald and M R McMurray Pp 26 (Newport, Shropshire Harper Adams Agricultural College) 6*d*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1598 (S and C 496, 563, 582, 599) The Landing of Aeroplanes Part 1, by R P Alston , Part 2, by L W Bryant and I M W Jones Pp 16+18 plates 1*s* 3*d* net No 1599 (T 3508) Resistance of certain Strut Forms By Dr. R Warden Pp 11+11 plates 1*s* 9*d* net (London H M Stationery Office)

Imperial Bureau of Plant Genetics Herbage Publication Series, Bulletin No 16 The Theoretical Significance of Vernalization By Prof N A Maximov Pp 14 (Aberystwyth) 2*s* 6*d*

Proceedings of the Royal Irish Academy Vol 42, Section B, No 5 A Contribution to the Flora of Ireland By Dr R Lloyd Praeger. Pp 55-86 1*s* Vol. 42, Section B, No 7 The Glaciation of the Wicklow Mountains By A Farrington Pp 173-209+plates 4-5 1*s* (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd)

International Federation of University Women Bulletin No 16 Report of the Nineteenth Council Meeting, Budapest, September 1934. Pp. 72. (London)

Leeds University Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1933-34 Pp 20 (Leeds)

OTHER COUNTRIES

New Zealand Department of Lands and Survey Annual Report on Scenery-Preservation for the Year ended 31st March 1934 Pp 8 6*d* Annual Report on Public Domains and National Parks of New Zealand Pp 9 6*d* (Wellington, N Z Government Printer)

U S Department of Agriculture Technical Bulletin No 426 The Relation of Fertilizers to the Control of Cotton Root Rot in Texas By H V Jordan, P R Dawson, J J Skinner and J H Hunter Pp 76 10 cents Technical Bulletin No 447 The Pepper Weevil By J C Elmore, A C Davis and Roy E Campbell Pp 28 5 cents (Washington, D C Government Printing Office)

Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series A, No 26 Technological Reports on Standard Indian Cottons, 1934 By Dr Nazir Ahmad Pp iii+86 (Bombay) 1 8 rupees

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès-verbaux des réunions, Vol 91 Report of the Meeting of Salmon and Trout Experts in Poland, October 1933 Pp 28 (Copenhague Andr Fred Høst et fils) 1 00 kr

Publications of the South African Institute for Medical Research No 34 Studies on Cell Growth Part 2 The Growth *in vitro* of Normal Mouse Cells and of Mouse Cancer Cells (Carcinoma, Sarcoma) in Natural and Immune Media (Serum Plasma) By Dr M J A des Ligneris Pp 309-322+28 plates (Johannesburg)

Tide Tables for the Atlantic Coast of Canada for the Year 1935 including the River and Gulf of St Lawrence, the Bay of Fundy, Northumberland and Cabot Straits, Hudson Bay and Information on Currents, in addition, Tide Tables for New York and Boston, U S A (Thirty ninth Year of Issue) Pp 96 (Ottawa King's Printer)

South Australia Annual Report of the Director of Mines and Government Geologist for 1933 Pp 13 (Adelaide Government Printer)

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 143 The Hygienic Interrelationship of Human and Animal Tuberculosis By Dr A M Wahby Pp 25 (Cairo Government Press) 4 P T

Geological Survey Department Tanganyika Territory Short Paper No 12 The Saragura and Associated Gold Occurrences of the Mwanza Area By F B Wade, with Petrographical Notes on the Specimens Collected, by F Oates Pp iii+44 (Dar es Salaam Government Printer) 4*s*

Annalen van de Sterrewacht te Leiden Deel 15, Stuk 4 General Catalogue of Positions and Proper Motions of 1190 Standard Stars in the Areas 2-115 of Kapteyn's Plan of Selected Areas By C H [illegible] Pp 86 (Leiden)

Memoirs of the India Meteorological Department Vol 26, Part 4 Discussion of Results of Sounding Balloon Ascents at Poona and Hyderabad during the Period October 1928 to December 1931 By Dr K R Ramanathan and H P Ramakrishnan Pp ii+51-77+8 plates (Delhi Manager of Publications) 2 8 rupees , 4*s* 6*d*

Bulletin of the Vanderbilt Marine Museum Vol 5 Scientific Results of the World Cruise of the Yacht *Alva*, 1931, William K Vanderbilt, Commanding Crustacea Stomatopoda and Brachyura By Lee Boone Pp 210+10 plates (Huntington, L I Vanderbilt Marine Museum)

Bulletin of the American Museum of Natural History Vol 68, Art 1 Mammals collected by A W Anthony in Guatemala, 1924-1928 By George G Goodwin Pp 60+5 plates (New York City)

University of Colorado Bulletin Vol 34, No 14, General Series No 350 Abstracts of Theses for Higher Degrees, 1934 (University of Colorado Studies, Vol 22, No 1) Pp 78 (Boulder, Colo University of Colorado) 1 dollar

Bulletin of the American Museum of Natural History. Vol 68, Article 2 The Penaeidea of Louisiana, with a Discussion of their World Relationships By Martin D Burkenroad Pp 61-143 (New York City)

Cornell University Agricultural Experiment Station Bulletin 597 Relation of Quality to the Retail Price of Eggs in New York City By A R Gans Pp 52 Bulletin 598 Governmental Costs and Taxes in some Rural New York Towns By H M Haag Pp 50 Bulletin 611 Vegetable-Crop Production in Suffolk and Nassau Counties By F O Underwood Pp 64 Bulletin 612 [illegible] Crop and Pasture Management for Herkimer County, New York Part 1 Soils and Field Crops, by A F Gustafson , Part 2 Pastures, by D. B Johnstone-Wallace , Part 3 Soil Map and Soil Types, by F B Howe and A F Gustafson Pp 83 Memoir 164 Aquatic Diptera, Part 1 Nemocera, exclusive of Chironomidae and Ceratopogonidae. By O A Johannsen Pp 71+24 plates. Memoir 166 Acidity, Antacid Buffering and Nutrient Content of Forest Litter in relation to Humus and Soil By Max J Plice. Pp 32. Memoir 167 Factors affecting the Development of the Cotyledonary Buds of the Common Bean, *Phaseolus vulgaris* By C F Moreland Pp 28+2 plates Memoir 168 Studies of the Effects of Storage Temperature on the Propagation Value of Potato Tubers By John D Hartman. Pp 39+3 plates (Ithaca, N Y)

CATALOGUES, ETC

Radiostoleum (Standardised Vitamins A and D) its Uses and Applications in Medical Practice Pp 20+2 plates (London The British Drug Houses, Ltd)

The *Chemist and Druggist* Diary, 1935 Pp 434+Diary (London The *Chemist and Druggist*)

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Individuality in Industry

ATTENTION has frequently been directed in recent years to the growth of the professional spirit among those responsible for the control and organisation of industry, whether on its financial, commercial or technical side Mr C H Bailey was not therefore breaking fresh ground in stressing this point in a recent stimulating address to the Birmingham and District Association of the Institution of Civil Engineers Already industry is being regarded as a public service—it is judged less by its capacity for earning profits than by the service it renders to the community to a much greater extent than formerly, Sir Josiah Stamp's reference to the service and profit motives in industry at the British Association meeting in Aberdeen was a warning against hasty conclusions as to the adequacy of the service motive alone, rather than a dissension from this view of the importance of industry

The professional ideal of fitness for a purpose which is implicit in technology makes the professional contribution to industrial efficiency all-important in these days In the address to which we have alluded, however, Mr Bailey proceeded to show how professional institutions, in providing a standard of professional conduct and skill for those engaged in the technical direction of industry, cannot fail to be concerned with the changes in the structure of industry and society which are taking place through mechanisation. It is not merely that the professional spirit requires them to consider the type and size of the industrial unit or organisation which can serve most efficiently the needs of industry and the community They must also consider such questions in relation to the well-being of members of their own profession and of society as a whole

Loyalty to the highest professional ideals involves the consideration of these larger social questions If machines, for example, can be used most efficiently, from the mechanical point of view, in large concentrations, the professional man must also consider the consequences of such concentration on individual incentives and initiative If such concentration seriously limits the opportunities for the expression of individuality and destroys incentives by removing many of the opportunities for rising sooner rather than later to a position of free responsibility, the depressing effect on the quality of industrial recruits must soon or later be seriously reflected in the efficiency of the industry.

The gravity of the check to the mobility of industrial labour, which has been imposed alike by the mechanisation of industry and by changing educational conditions, is as yet not generally realised, although it has been emphasised in recent discussions on technical recruitment for the cotton industry The importance of adequate incentives in large-scale industry was, however, a main theme in the important address delivered by M H Dubreuil before the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association, and it strongly supports the contention that the essential problem is to organise mechanical manufacture in such a way that it affords more men the opportunity of using their capacities to the fullest extent. Mr Bailey's suggestion that industry should perhaps be organised more in small units in which more men could look forward to occupying positions of real responsibility, is not so much an attack on the size of industrial undertakings, or a pessimistic assertion of limits to the organising capacity of the human mind, as a reminder that, in the long run, industrial efficiency cannot be dissociated from social efficiency, and as such deserves careful consideration

The problem of securing free play for individuality is as vital to industrial success as it is in scientific research or other activities Without it, team work is apt to degenerate into something mechanical in which creative ability and original thought languish Management, in fact, consists in taking care of the fundamental principles of organisation which implicitly respect the individual, and applying them to the purposes of the undertaking, and such principles have nothing to do with the size of the undertaking J M Scott's tribute to Watkins's knack of making everyone a 'boss of something', and so allowing him to feel a personal glow of pride in every achievement, is not more an explanation of the success of an expedition of three men and a team of dogs in the heart of Labrador than it is the secret of successful management in the largest industrial organisations that exist

M. Dubreuil's paper on autonomous groups in industry is of interest in this connexion, as indicating how wide a research field management still presents in just this matter of delegating responsibilities and associating the workers with the success of the undertaking in which they are employed In such research the professional spirit as well as scientific method must play its part, and while even from the narrowest professional point of view any institution such as the Institute of Chemistry or the Institution of Civil Engineers must recognise a real responsibility to its younger members to ensure that they have opportunities of utilising fully their ability, that responsibility is most wisely discharged when it is seen as part of the wider social and industrial responsibilities of the profession

Discussions on the decline in the number of students attending technical courses of training for the cotton industry have once more emphasised the necessity for each great industry to consider both the quantity and the quality of its recruits Unless an industry can make up its mind what numbers of recruits it needs, from what types and grades of schools or institutions they should be drawn, and in what proportion, and couples with this an adequate system of training and promotion, there is grave danger that the industry will find itself without a supply of recruits of the requisite calibre, or at least with such an insufficient supply that its efficiency is seriously affected and its power of expansion or recovery is impaired

The extent of juvenile unemployment and the situation revealed by the reports on the depressed areas in the Midlands and North of England may easily engender a false confidence in industry at the present time No industry can afford to recruit continuously, whether in its lower or its higher ranks, from those whose morale has been undermined by continuous exposure to intermittent or blind-alley employment and who are, in desperation, prepared to accept any situation which offers the prospect of steady work irrespective of their capacity. Nor can any industry ignore indefinitely the value of a planned policy of recruitment, training and promotion as a means of attaining the efficiency which enables it to hold its own in days of severe and unremitting international co-operation.

The question of industrial training and recruitment is thus one which is forced upon the attention of professional men in industry in many ways Loyalty to their own junior colleagues demands its consideration. Their responsibilities as managers lead them to the study of new methods for securing the continuous co-operation of members of their staff and developing the morale and team spirit which are essential to efficiency and success.

Finally, the social responsibilities of industry demand the study of industrial structure and organisation, recruitment, location and planning of industries, so as to serve those general interests of the community with which ultimately the interests of industry are inseparably linked It is when these problems are approached from the point of view of life as a whole, and not merely of production, that the professional workers will succeed in making the contribution to industrial efficiency and social welfare which the community has a right to expect

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Reviews

Philosophy in the Garden

The Genetics of Garden Plants By M B Crane and W J C Lawrence Pp xvi+236 (London Macmillan and Co, Ltd, 1934) 10*s* 6*d* net

THE occupation of gardening is both ancient and honourable, though it is only in comparatively recent times that those engaged in it have paid much attention to the origin of the material with which they work Whether for utility, for medicinal use or for sheer beauty, European gardeners in older days were content to grow the plants that they found to hand, adding to them such new things as were brought in by the voyagers gradually exploring the world. To their enthusiasm and energy the works of the herbalists bear witness But while these noble compilations were in progress a new era in horticulture was dawning The discovery of the nature of sex in plants, initiated by Camerarius and so ably followed up by Kolreuter, led to the organised production of novelties through the method of hybridisation

The great burst of work of this kind throughout the nineteenth century, so closely associated with the names of Knight, Herbert and Laxton in Great Britain, and of Louis Vilmorin in France, led to a vast enrichment of the flower and vegetable borders as well as of the orchard Meanwhile, the philosopher had wandered out of his study into the garden Developments so notable had begun to attract his attention, to challenge him to fit them into his scheme of things The challenge was taken up, and philosophy's very considerable gift to the horticulturist was the second volume of Darwin's "Animals and Plants" The excellencies of the cultivated had arisen from the plebeian wild through the skilful selection of man Philosophy applauded the solution, but what was selected, how it arose, and how it was perpetuated, philosophy was content to ignore

Of all these things the gardener took little heed He continued his usual practice, and the flow of newer and more beautiful things went on. Then came another philosopher who was also a gardener Gregor Mendel disclosed the nature of heredity, and the disclosure gave more than a hint as to the manner in which fresh variations arose But Mendel's posthumous achievement was even greater He forced the philosopher himself to become a gardener, and to this new combination William Bateson, its first great exemplar, gave the name geneticist Then fortune felicitously intervened John Innes, of the Manor House at Merton, died, bequeathing property and money for the furtherance of horticulture The trustees, in appointing Bateson as director of the new institute, showed both foresight and courage, for there was not a little head-shaking over the matter in horticultural circles To the third philosopher was given opportunity and a garden, and this book, dedicated to his memory by two of his old pupils and colleagues, sets forth the outcome from the horticultural point of view

Following a brief introduction to Mendelian principles the volume is chiefly concerned with polyploidy and incompatibility, both phenomena of paramount importance to the horticulturist, in the elucidation of which the John Innes Institution has played a major part With the establishment of the chromosome theory of heredity by the *Drosophila* workers in America, more and more attention was paid to the chromosome content of other forms of life, and it soon became apparent that many of the more marked horticultural varieties show marked differences in the number of their chromosomes, generally in the direction of increased number as compared with the wild or more primitive forms Sometimes this increase is of the nature of simple doubling of the sets already present, as in the giant forms of the Chinese primula In other cases, different sets of chromosomes were found to be 'superadded', leading to the formation of a new type of plant, self-fertile and breeding approximately true to type but sterile with the parent forms—in short, a new species So arose *Primula kewensis* from *P floribunda* and *P. verticillata*.

The possibilities inherent in polyploidy are enormous, and the complexities also are very great. Yet if the horticulturist is to understand his material and to continue to make headway he must have some acquaintance with the chromosomes and their vagaries, and nowhere will he find a better introduction to this study than that which is here provided It was a happy thought on the part of the authors to illustrate their teaching by an account, partly historical and partly analytical, of various flowering plants and vegetables For each plant may differ in the course of its civilised progress The sweet pea has progressed by means of simple gene mutations alone, to this the Chinese primula has added polyploidy, while into the garden dahlia has entered hybridisation also, and we would commend the section dealing with this plant as a résumé of one of the most beautiful pieces of analytical horticulture on record

Fascinating as is the study of polyploidy in the flower border, it is of more practical importance in the orchard. Cox may be the perfect apple and Comice the perfect pear, but each has its short season and other drawbacks, and the localities are limited where they can be profitably grown There is both room and need for many finer varieties than now exist But, as earlier workers have found, breeding trees is a slow business and full of disappointments Some of these in the past have been due to the existence of polyploidy among many of our best varieties, which were those naturally chosen to breed from On this subject the authors offer many illuminating facts as well as a valuable discussion which should be most helpful in guiding future work

The existence of polyploidy is not the only difficulty with which the breeder of new fruits has to reckon Many varieties show what is termed 'incompatibility' with one another The pollen of variety *A* may be perfectly good, yet unable to fertilise *B*, though with *C* it will cause the fruit to set Careful and long-continued analysis at the John Innes Institution has shown that the many varieties of cherry fall into definite groups such that the members of a given group all show incompatibility with one another, yet at the same time their pollen can fertilise members of other groups and lead to fruit production The existence of such groups—and they are found in other fruits besides cherries—is based upon definite genetical factors Such knowledge is not only essential to the plant breeder, but is also most important to the grower when he comes to select varieties in the planning of his orchards For where incompatibility is found, judicious interplanting of different varieties is essential to good results

As sound practical horticulturists, the authors have throughout kept the gardener in the forefront of their minds, and no gardener of imagination and intelligence can fail to be grateful for their clear and sympathetic exposition of the present state of knowledge in these matters But as is fitting and inevitable, philosophy keeps breaking through Illuminating as this book must be for the trained gardener, we venture to think that it will be even more so for those who are sometimes termed 'pure scientists'. For in their analysis of garden plants the authors are continually shedding fresh light on the nature of species itself It is clear that the manifestation of variety in the living thing is intimately bound up with the nature and arrangement of the chromosomes About these little bodies much has already been learned through hybridisation and the systematic study of polyploidy Recently, in X-rays the geneticist has found a new tool He is already learning to produce new variations, though as yet the tool is far from being under control Control, however, will come in due course, and with it perhaps the advent of the fourth philosopher

Fossil Birds

Handbuch der Palæornithologie. Von Prof Kálmán Lambrecht Pp xix + 1024 + 4 plates (Berlin Gebruder Borntraeger, 1933) 108 gold marks

THE fossil remains of birds are usually only isolated bones Even these are rare in most of the rocks which contain them, and those which have been collected are widely scattered among numerous museums The few known bones of a Pliocene ostrich from Samos, for example, are in four museums in three different countries We therefore welcome an exhaustive treatise on these fossils by Prof K Lambrecht, of Budapest, who has devoted many years to a study of the subject He has not only prepared a critical summary of the literature, but has also examined the actual fossils in museums, and can thus write with first-hand knowledge He has made many new observations, and he has also discovered important specimens which have hitherto been overlooked His work is well illustrated with outline drawings and beautiful photographs, many of them original, and a few copied from published figures which are not readily accessible

Prof Lambrecht begins with a general account of the osteology of birds, accompanied by a series of good drawings which explain the various technical terms used in describing the bones He then prefaces his systematic account of the fossil birds by a short historical introduction, which is illustrated by portraits of Richard Owen, A. Milne-Edwards and O. C Marsh, who were pioneers in describing and interpreting the fragmentary specimens. He also briefly summarises his classification into orders, beginning with the Archæopterygiformes and ending with the Passeriformes, without any grouping into larger divisions He does not recognise the Odontornithes of Marsh, but places the Cretaceous toothed birds close to the surviving orders to which he considers they are related

The systematic descriptions are most exhaustive, with long bibliographies and numerous tables of distribution of the genera and species of the several orders Some of the lists of the literature may perhaps be considered too exhaustive, even a story of Aepyornis Island by H G Wells, for example, is included There are, however, many interesting novelties which enliven the technical compilation, such as the first photographs of the fragment which Marsh named *Laopteryx*, and drawings of the rudimentary wing bone of *Aepyornis* There is also a useful stratigraphical and geographical list of genera and species

A final chapter on the general palæontology and palæobiology of birds is remarkably comprehensive Modes of fossilisation, feathers, footprints, eggs, gizzard stones, coprolites, guano and even nests are discussed A fossilised nest from the Upper Miocene of Wurtemberg, which is shown in a beautiful photograph, is especially noteworthy Then follow remarks on the ways in which birds are adapted to their different surroundings and modes of life, and the concluding pages are devoted to the problems of evolution

Prof Lambrecht is indeed to be congratulated on having produced a handbook which is not only indispensable for all who study birds, but is also filled with matter of interest to every biologist

A S W

The Planet Mercury

La planète Mercure et la rotation des satellites étude basée sur les résultats obtenus avec la grande lunette de l'Observatoire de Meudon Par E -M Antoniadi Pp v+76+3 plates (Paris Gauthier-Villars, 1934) 18 francs

THIS little book does not belie the author's international reputation—the old adage, "Small bulk but guid gear", sums it up tersely, containing as it does matter to please and interest both the general reader and the serious student of astronomy The monograph contains five chapters, namely generalities, transits of Mercury, geography of Mercury or hermography, and rotation of the planet, atmosphere and mists of Mercury; the physical conditions of the planet, and a table of contents

From the comprehensive opening summary of the oldest records with references, it is worthy of note that the early Egyptians, Chaldeans and Greeks recognised the identity of the evening and morning star Again, the Egyptian priests, followed by the Pythagoreans and others, and much later, by Copernicus, discovered that Mercury, like Venus, moved round the sun Orbital elements and an explanatory diagram of the varying elongations are given together with the ancient names, evolution of symbols personifying quick motion, old and modern colour and brightness comparisons, Hevelius's discovery of the phases and that of their deficiency of Schroetor

Transit records from 1631 until 1927, disc distortion at ingress and egress, light spots and the phenomenon of the complementary fringe around the black disc masking the extent of a Mercurian atmosphere are discussed

The geography of Mercury, or hermography, and the rotation of the planet form the third and principal chapter—one of absorbing interest Summarising the work of the past and present centuries, M Antoniadi, authorised by M Deslandres to make a systematic research on Mercury, describes his observations from 1924 until 1929 with the 0 83 metre (33 7-in) refractor of the Meudon Observatory His results and those of other observers agree generally with Schiaparelli's work both in the form and location of the surface features and the equality of the rotation period of 87 97 days with the revolution round the sun A chart (Schiaparelli's is also reproduced for comparison) shows the light and dark markings appropriately christened from the Greco-Egyptian mythology of the great god Mercury Generally, the observations show that. (1) the light areas are more extensive than the dark regions and show luminous spots as on Mars and the moon; (2) the visible portion of the southern hemisphere is darker than the northern as with the earth and Mars

Libration, due to uniform angular rotation with variable orbital speed, illuminating 228° in longitude of the planet and leaving 132° in continual darkness, is explained Tidal frictional force maintaining similar conditions on large satellites is also investigated

Discussing the meteorology of the thin yet deep atmosphere of Mercury, with its shifting banks of suspended dust, the low albedo of 0·13 is inferred for reflection from a rough surface covered with broken rocks and dust

That tin and lead would melt under a vertical sun reveals a very hot surface A vivid—in part 'dramatic'—description of the state of Mercury makes no reference to radioactivity or to pressure of radiation M. Antoniadi quotes Flammarion regarding life—"The forces of Nature produced different effects according to circumstances, and that all life cannot be excluded from Mercury", again, in p 69, the author admits the possibility of microbic life at the Mercurian poles The reviewer agrees, and thinks that although the planets may not support *terrestrial* life, the probability of cosmical life, of a form outwith our conception, might be envisaged

A survey of the sky as seen from Mercury concludes the memoir, which is embellished by three plates and many fine drawings and diagrams

H McEWEN

French Psychology

Nouveau traité de psychologie Par Prof Georges Dumas Tome 2 *Les fondements de la vie mentale* Pp vi + 612 Tome 3 *Les associations sensitivo-motrices, l'équilibre et l'orientation, l'expression des émotions, les mimiques, le langage* Pp vi + 462 (Paris Félix Alcan, 1932–1933.) 100 francs each.

THE French school of psychologists, led by Dumas and Piéron, have many important investigations to their credit In their work, the refinement of detail is happily harmonised with those broad synthetic views which connote the classical character of the French mind The collective treatise on psychology which will be completed in nine volumes, and of which vols 2 and 3 are under review, is an outstanding result of team work relating to one of the most exacting of sciences. While the first volume, published some time ago, dealt mainly with questions of method, the second volume is devoted to the foundations of mental life Here we find a detailed analysis of the relations between various kinds of stimuli and the reflexes, movements and secretions of the body, also of the sensitive and affective elements of mental life, such as the various types of sensations, pleasure and pain, emotions and tendencies, and finally of imagery and the relations between image and thought All these questions are well treated by G Dumas, H Piéron, A Mayer, B Bourdon, J Larguier des Bancels and I Meyerson The study of the affective states (especially of emotion and of pleasure and pain) by Prof G. Dumas and the monograph on images by I Meyerson are remarkable examples of orderly exposition and unbiased discussion of results

The third volume deals specifically with the major sensory-motor functions, such as orientation and bodily equilibrium, the expression of emotions, mimicry and language Prof Dumas rightly holds that no psychological functions are purely sensory or purely motor, though, of course, when analysing them one of these aspects may be stressed to the exclusion of the other The study of vision, for example, which is generally considered as a purely sensory function, involves an important background of motor responses and muscular reflexes. The chapters on the expression of emotions are most interesting in their details, both in regard to the methods adopted and to the cases observed or quoted Attention, surprise, astonishment, joy, sadness, fear and anger are analysed not only as mere expressions of emotions, but also as results of physiological stimuli Indeed what adds to the value of this volume is the fact that all experiments and observations are explained or discussed with due consideration of the physiological changes involved in each case The two monographs by A Ombredane on orientation and on language show the same qualities

The value of the first three volumes of the "Nouveau Traité de Psychologie" causes one to await with eagerness the publication of the rest of this great work It cannot be said that the French psychologists form a distinct and original school of thought But their work is important precisely because of their detachment from any labelled group of scientific workers Prof Piéron might perhaps be counted as a behaviourist, since he was led by his animal studies to define psychology as the study of behaviour before Watson used that formula But Prof Piéron is more clear-headed than the American behaviourists, as Prof Wordworth pertinently pointed out, for he sees no necessity for calling into question the individual's testimony to his own consciousness Prof Dumas, too, gives much weight to introspection In spite of its difficulties, this method is really indispensable in psychology, since it has furnished the suggestion even for the objective studies that have been carried on, and since it supplies the personal interest which one finds in psychological results

The main characteristics of French psychology, however, are its emphasis on the biological basis and the social setting of the individual's activities, and also its interest in psychopathology These characteristics are very prominent in the volumes under review and enable their authors to steer a middle course among the growing complexities of psychological research T GREENWOOD.

Teaching of Elementary Physics

A Textbook of Physics By E Grimsehl Edited by Prof. R Tomaschek Vol 2. *Heat and Sound* Pp xi+312 12s 6d net. Vol. 3 *Electricity and Magnetism* Pp xiv+685. 25s. net. Vol 4. *Optics.* Pp xii+301+17 plates 15s net. (London, Glasgow and Bombay: Blackie and Son, Ltd, 1933.)

THE teaching of elementary physics in British schools and universities will be materially assisted by the appearance of these three volumes of Dr Grimsehl's "Textbook". The high standard set in the first volume has been maintained throughout in the present volumes, and in certain respects the English edition may be said to be an improvement on the German original

The translators have, on the whole, done their work well and have added useful explanatory notes whenever the original has appeared to be lacking in detail In vol 2, for example, Robert Mayer's calculation of the numerical relationship between work and heat from the difference of the specific heat of gases at constant pressure and constant volume is rightly criticised in a footnote which quotes from the works of Tait and Roberts

Among the special subjects treated in this volume are atomic and molecular rays (Dunoyer), zero-point energy, and Nernst's heat theorem In some cases the references are too brief to be considered useful, as on p 277, where Behm's sonic depth-finder is mentioned without a suggestion as to how it works The same applies to the electrical excitation of quartz crystals for producing ultra-sonic vibrations (p 265), a subject on which much interesting information might have been compressed into a small space The section on heat engines is clearly written and well illustrated Not the least interesting feature is the *great number of biographical notes scattered* throughout these volumes. We read on p 152 that K F Braun, who followed up and firmly established Le Châtelier's principle, was a professor at Strasbourg in the years preceding and during the Franco-Prussian War, and that in recognition of his valuable work in wireless telegraphy he shared the Nobel prize in physics with Marconi in 1909 He died in the United States, where he was staying at the outbreak of the European War and had been interned

The section on waves is comprehensive, resonance and coupled oscillations are treated with great didactic skill The last part deals with sound Here the treatment of Kundt's tube experiment must be regarded as inadequate But the blemishes are few, and the volume deserves a warm welcome

Vol 3 has been considerably revised and supplemented by Prof. Tomaschek as compared with the last edition issued by the original author The result is in every way excellent Many novel methods of treating electrical phenomena are given and it is gratifying to find that difficulties have not been shirked For example, a simple but thoroughly useful account of the electron theory of metals is given and is afterwards applied to explaining the ultimate mechanism of electromagnetic induction In a small section on "Waterfall and Thunderstorm Electrification" there is a quotation from Lenard that "no double layer is formed at the interface between water and air" The succeeding sentence runs . "on the contrary small droplets of diameter less than 10^{-4} cm prove to be negatively charged when detached from the water surface" An examination of the context shows that "on the contrary" is misleading here as a translation of the German word *hingegen*, which has only the strength of "however" on this occasion For we know from Lenard's own work, as is mentioned on the next page, that an electrical double layer *is* actually formed at the surface of water but within itself Attention may be directed to a slip in the index where a joule is given as equal to 10^7 dynes , it is given correctly, however, in the text

As these books by Dr Grimsehl make a point of furnishing biographical and historical details connected with important physical discoveries, it is surprising to find no mention of the earliest determinations of the elementary electric charge Reference is made only to the work of Ehrenhaft and Millikan This is a case where an illuminating note by the translator would have been welcomed In some instances the account is rather meagre, for example, the treatment of potentiometers (p 233) and of the ballistic galvanometer (p 317) , and occasionally we find that familiar English expressions have been omitted English, and for *the most part also foreign, students are accustomed* to seeing the left- and right-hand rules linked with Fleming's name, and the theorem concerning the equivalent magnetic shell associated with Ampère Nor is Townsend's name mentioned in connexion with ionisation by collision, a discovery of outstanding importance

The chapter on high-frequency oscillation is very clear, but there is no mention of electrodeless discharges Again, in dealing with thermionic valves, it would have been an advantage to introduce accepted English terms such as differential internal resistance, anode slope resistance and so forth On p 598 the Schottky-Langmuir formula deserves equal emphasis with that of Barkhausen

Many readers will have been unacquainted with the Johnson-Rahbeck effect (p 210) discovered in 1920, which makes it possible to use the force of attraction of a charged plate condenser in place of an electromagnet for mechanical action. The treatment of generators and motors is excellent and the accompanying diagrams exceptionally good

This volume is perhaps the most stimulating of the four that have so far appeared We may guess that the author is here dealing with his favourite subject The way in which the material is presented confirms that Dr Grimsehl's high reputation as a teacher was fully deserved Vols 2 and 3 have been translated by Dr L A Woodward.

Little more need be said of vol. 4 than that it maintains the high standard of the preceding volumes of the series and that the illustrations are quite exceptionally good in many cases, as for example, plate VII facing p 92, which shows the tracks of rays through thick lenses, and plate XII, which indicates how a cardioid condenser (of the Siedentopf type) acts Although a good plate (XIII, facing page 154) is given of spectra photographed by Gerlach and Schweitzer for deducing the composition of a mixture of tin and a small percentage of cadmium, no reference is made in the text to the diagram or to the fundamental principle underlying photographic spectrophotometry There is a good section on autochrome photography but no account of ordinary photographic processes, or of the density curves of photographic plates There is an interesting laboratory experiment devised by Dr. Grimsehl himself to explain the formation of rainbows Some of the less well-known effects of light are conveniently enumerated, such as the Weigert effect (action of polarised light on exposed photographic paper)

This volume, which has been translated by Winifred M Deans, will be useful both as a textbook and as a reference book for those acquainted with only the elements of the subject No doubt the last volume of the series (on atomic physics) will supplement the section dealing with spectral lines, so that the five volumes will constitute a complete elementary course in physics

H L B

Short Notices

Dipole Moments a General Discussion (Reprinted from the *Transactions of the Faraday Society*) Pp ix + 677 904 + lxxxvi (London and Edinburgh Gurney and Jackson, 1934) 21*s* net

THIS reprint contains the account of the proceedings of the General Discussion held in April (see NATURE, **134**, 802, May 26, 1934) together with an appendix consisting of a table of values of dipole moments for which Dr N V Sidgwick and two collaborators are responsible This appendix is a most valuable part of the report, since it contains not only the numerical values of the moments of a large number of substances, but also references to the original publications and such information as may be required in the interpretation of the data The discussion dealt with the dielectric constant, the determination of dipole moments and the interpretation of dipole moments, and the papers contributed and the discussions on them are now available The volume is one of considerable interest and value, and the Faraday Society is to be congratulated both on the success of the meeting at Oxford and also on the very material addition to knowledge which is represented by this volume The type of binding of the reports has been improved

The Surgery of the Sympathetic Nervous System By Prof George E Gask and J Paterson Ross Pp xii + 163 + 13 plates (London Baillière, Tindall and Cox, 1934) 16*s*

THE surgery of the sympathetic nervous system is yet in its infancy Our knowledge of this system itself is none too well developed, so that its surgery must of necessity remain in the experimental stage until our knowledge of the pathology is sounder

The authors give us the results of their work in the surgical unit at St. Bartholomew's Hospital The main body of the work is divided up into three divisions dealing with sympathectomy for disorders of (*a*) the circulation, (*b*) the visceral motor mechanism and for the relief of pain Their results in some types of case which have been regarded as more or less intractable to treatment are surprisingly good, and we hope that the work, when fully developed, will yield results of even startling character.

Bilder zur qualitativen Mikroanalyse anorganischer Stoffe Zusammengestellt von Prof W Geilmann Pp 12 + 40 plates (Leipzig Leopold Voss 1934) 8 gold marks

THIS collection of 240 photomicrographs in 40 plates illustrates the forms of the particles of precipitates produced by analytical reagents The reproductions are exceptionally good, and the forms of the crystals, the degrees of magnification and the conditions of precipitation are given, so that the results are free from ambiguity The photomicrographic procedure is also briefly described

Although the utility of microanalytical methods in a large field has undoubtedly been over-estimated by enthusiasts, they can play a very useful rôle in the confirmation of ordinary qualitative analysis in normal cases, and in cases where only a small quantity of material is available they become of increasing importance Prof Geilmann's book is very handy in size and contains practically all the cases met with in normal practice, so that it may be recommended as likely to find favour in analytical laboratories It is convenient in size, as compared with some earlier publications in atlas format, and will meet the requirements of all except the specialist in this field.

Materiewellen und Quantenmechanik: eine Einführung auf Grund der Theorien von de Broglie, Schrödinger, Heisenberg und Dirac Von Prof Dr Arthur Haas Vierte und Funfte, verbesserte und abermals wesentlich vermehrte Auflage Pp viii + 299 (Leipzig , Akademische Verlagsgesellschaft m b H , 1934) 7 80 gold marks

THE first German edition of this work and its English translation were reviewed in NATURE of March 9, 1929 (p 362) Since that time it has been more than doubled in thickness by the addition of chapters on parahydrogen, Dirac's theory of the electron, the positron and applications of the Fermi statistics to metallic electrons. As before, stress is laid upon fundamental principles rather than detailed mathematical proofs, for which the reader is referred to the original sources, so that the book will appeal to anyone who desires an up-to-date and, within limits, a readable account of recent work in atomic physics.

Problems and Progress in Photography*

By OLAF BLOCH, Research Laboratory, Ilford, Ltd.

PHOTOGRAPHY is the recording angel of the arts and sciences, but it is to be hoped that angels of other classifications do not have to endure the insistent requests for materials possessing incompatible properties which are demanded of the photographic chemist. Perhaps the most difficult problems are presented by the physicists and astronomers, who require grainless emulsions of extremely high speed, sensitive to all the visible spectrum, or any portion of it—with extensions into the ultra-violet and infra-red regions!

For work in the neighbourhood of the $H\alpha$ line, two types of emulsion are now available, one which attempts to give the astronomers a maximum sensitivity at $\lambda6500$, and another, which has fairly even sensitivity round this region of the spectrum, extends well beyond. The spectrum of meteors has been successfully photographed by Williams, of the Steward Observatory, and for this purpose an emulsion of great speed and high green sensitivity was necessary. Other recent emulsions include one with a maximum at $\lambda5300$ for work on the solar corona, and another, for lunar disc photography, of fine grain and high contrast, where an attempt has been made to compensate for the low speed by extreme colour sensitising.

In the region of atomic physics, properties of another kind are desirable. For α-particle and proton track work, it is essential that the grain of the emulsion should be fine, resolving power high, and that the unexposed portions should yield but few or no silver grains upon development. Normally, emulsions have about $3\cdot5 \times 10^6$ such grains per cm.^{2} when developed without exposure, the average size of these being dependent upon the size of the silver halide crystals; but a recent product of the emulsion maker's art gives almost complete freedom from these.

Quite different requirements are necessary for work with atomic rays and in the extreme ultra-violet. Here the radiation has little penetrating power and is readily absorbed by gelatine. Hence, only sufficient gelatine must be used to bind the silver halide, or the crystals of the latter must be made to project beyond the gelatine surface—a rock-garden effect! The Schumann plates, always somewhat untrustworthy, are of the former type, and recently an emulsion of the latter kind has been produced which appears to be sturdier and more constant in its properties.

There are two main sections in photography: first, its applications, including the important function of recording; and secondly, the internal problems of the subject, dealing largely with the mechanism of emulsion making and the effect of light upon the sensitised silver halide. The function of gelatine in emulsion making is complex: first, it holds silver halide in suspension, a suspension by no means perfect, since sedimentation usually takes place when the liquid emulsion is allowed to stand. Secondly, it is the principal means by which speed can be obtained; and thirdly, it prevents too rapid reduction of the unexposed silver halide in the developer, whilst permitting a sufficiently slow reduction of the latent image to enable control to be exercised. The amount of gelatine necessary to produce suspension is very small, so little as 1 gm. of gelatine per 100 gm. of silver halide being effective. Discussion is still rife as to the mechanism of the silver halide gelatine system, one argument being that bodies in the gelatine, having the iminazole and azine linkages, tend to form adsorbed layers of the protective colloid on the silver halide surfaces. It has not been found possible to remove the gelatine entirely from the latter by centrifuging and subsequent washing, and whether the retention of the gelatine is mechanical or otherwise, it would probably not be without effect upon the resulting emulsion.

The silver halides are all light-sensitive and darken when exposed to light, free halogen and metallic silver being amongst the reaction products when the intensity is sufficiently high, but exceedingly low intensities suffice to produce a developable latent image when the emulsion is in a highly sensitive condition. Very little is known about the changes which occur in these circumstances. It is at present generally held that the first action of light is the splitting off of electrons from the bromine ions in the silver bromide, with the consequent discharge of silver ions forming atoms of free halogen and free silver, the emulsion possibly becoming developable by reason of the altered position of the electric charges. The photo-electric effect does not appear to play a part, but it has been found that the photo-conductance of silver bromide in exceedingly thin layers increases and decreases in a manner corresponding to its spectral sensitivity in energy terms, the photo-sensitive units probably being the bromide ions. Also, in the case of a photo-voltaic cell consisting of electrodes of silver bromide coated on silver and in a bromide solution, the illumination of one pole sets up potential differences. In most of this work the suggestions are purely theoretical, or have resulted from experiments on precipitated or deposited silver bromide *per se*, or of silver bromide crystals in an isolated condition. Little of the work deals with the silver halide in its actual emulsion form. Such evidence as can be obtained depends almost entirely upon the action of a reducer in order to study the effect of light in producing the latent image, and we have very little real knowledge of the state of affairs existing in the silver halide crystal in emulsion form either before or after exposure. The conclusions reached at present are largely inferential and this remains one of the unsolved problems of photography. Also, we have no exact knowledge as to the relationship between light quanta and latent image.

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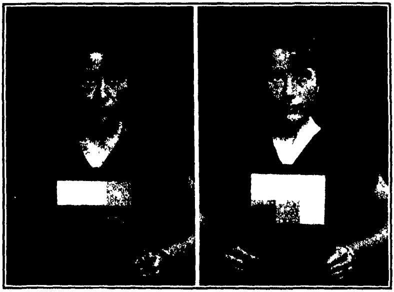
* Substance of three lectures delivered at the Royal Institution on October 30, November 6 and 13, 1934.



(*a*) (*b*)

FIG. 1. (*a*) Negative made on the unexposed portion of the characteristic curve of an emulsion and developed for a long time to secure maximum contrast. (*b*) Negative made on the straight line portion of the characteristic curve of the same emulsion and developed for a short time to secure minimum contrast.

One of the interesting discoveries was the existence of minute quantities of sulphur compounds of the thiocarbamide type in gelatine. When the gelatine was sufficiently purified to remove these, emulsions prepared with it were of low sensitivity, and the restoration of the sulphur-containing compound, at almost any stage of the emulsion making process, restored the sensitivity. In practice, the original sensitivity cannot be greatly exceeded by increasing additions of the sulphur compound beyond a certain point, since fog results. There would appear to be an adsorption of the sulphur compound on to the silver halide, subsequent reaction yielding silver sulphide in the form of specks which are supposed to be the sensitive nuclei.

Much work has been done upon this subject, and it has been supposed that the silver sulphide acts by deforming the ultimate structure of the silver bromide, thus affecting the silver and bromine ions, so that the photo-chemical decomposition might be more localised with a more ready splitting off of the bromine electrons. There is no doubt of the main facts, but it seems probable that it is only a particular case, since other substances not containing sulphur can act similarly, though less effectively, in the case of the desensitised gelatines.

A great deal has been done in the investigation of the phenomenon of development, and, in general, two views may be said to hold the field: one is that the reduced silver is dissolved in the developer and re-deposited; the other formulates the idea that the reducing ions of the developer are first adsorbed on to the silver, a re-arrangement afterwards occurring which gives metallic silver and oxidised reducer. The function of gelatine as a protective agent in reduction is not complete, since all emulsions show some reduction if the reducer is allowed to act for a sufficiently long period.

The mode of expression of the speed of an emulsion is still a vexed question, since it is impossible that one figure can express a variety of different properties in any one substance. Speed may depend upon the portion of the emulsion curve which is employed for the particular purpose in hand (Fig. 1, *a* and *b*), and a knowledge of speed alone need by no means be the first consideration—gradation, resolving power, graininess and other properties may be of equal or greater importance.

The older Hurter and Driffield method of expressing the speed depends upon the straight line portion of the characteristic curve, and this is a measure of the contrast (gamma) of the emulsion as well as of its speed, and is often inadequate. More modern methods, including the German DIN (*das ist normal*) system, depend upon some function of the under-exposure curve and yield a speed number which is, perhaps, more in accord with the requirements of those who take instantaneous camera pictures. There are many obstacles in the way of giving a brief statement as to the properties of any one photographic emulsion, the variation in the gradation and length of both the under-exposure and the straight line portion of the curve, the shape of the over-exposure curve and the exposure point at which it begins to function, the failure of the emulsion to obey the reciprocity law, may all enter into one or other of the uses to which the sensitive material is to be put. It is certainly important that some indication of the photographic quality of the material used should be given, but it is not possible to accomplish this satisfactorily until a much larger proportion of the camera-using public is educated to a higher photographic standard.

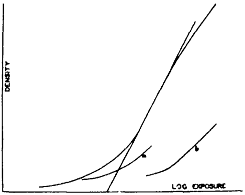


FIG. 2. Characteristic curve of the emulsion used in Fig. 1. Portion used in Fig. 1*a* is marked *a*, that used in Fig. 1*b* is marked *b*.

Two important properties of emulsions are resolving power and graininess. The former is a very complex quality, depending upon a large number of factors. It has been defined as the capacity of an emulsion to resolve a number of lines and spaces per millimetre, the lines and spaces being of equal dimensions. Some of the factors influencing it are the maximum contrast obtainable and the shape of the characteristic curve, the amount of scatter due to the film, its graininess, its spectral sensitivity, the size of the image, etc. Other factors are shape, range of contrast and spectral quality of the object, the amount of exposure, the treatment in processing, the aperture of the lens and the spectral quality of the light used for taking the photograph. Some of these operate in antagonistic directions; for example, resolving power decreases with grain size, but since emulsions of very small grain size are somewhat slow, their use is impracticable where high speed is required. In the same way, small lens apertures are not possible in the same circumstances.

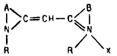
It is necessary, for many purposes, to enlarge the photographic image; for this reason, the cinematograph and the increasing use of the small precision camera have made the question of graininess an important one. Graininess might be defined as the distance at which the image of the silver deposit no longer appears uniform at constant magnification, or the magnification at which the silver deposit no longer appears uniform viewed from a constant distance. The question is a physiological one and a standard is therefore difficult to set up. Various methods, mostly visual, and chiefly comparative in character, are used for determining this property. Graininess depends mainly upon the emulsion itself, factors being the size of the original silver halide crystals and the extent to which clumping occurs, either in the emulsion itself, or as a result of development. Modern emulsion making has shown considerable advances in the direction of producing faster emulsions possessing a relatively fine grain, and it seems probable that these methods can be still further developed.

Optical sensitising is the term applied to the alteration of the spectral sensitivity of an emulsion by the addition of a dyestuff which is adsorbed by the silver halide and confers upon it an added sensitivity in the neighbourhood of the absorption of the dyestuff. So far as experimental data are at present available, the dye can be removed by the use of an inert solvent suitable for the particular dyestuff, with consequent loss of the added sensitivity. The sensitising power varies with the chemical composition of the dye, and the addition of substituent groupings can have a large effect, or the substitution of one grouping for another (for example, the change from a dimethyl to a diethyl grouping) can cause marked deterioration or improvement.

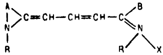
Ordinary emulsions are sensitive from about λ2100 to about λ5200, and optical sensitising does not greatly affect this inherent sensitivity. The amount of dye needed for optimal sensitising can be extremely small; in the case of one dye, for example, it is of the order of 1 gm. molecule of the dyestuff to 357,000 gm. molecules of silver bromide. In another case, at the other end of the scale, it is as large as 1 gm. molecule of the dyestuff to 6000 gm. molecules of silver bromide.

The smaller grains of the emulsion adsorb more dye than the larger, possibly owing to their greater area per unit mass, and this accounts for the higher contrast obtained when exposure is made to light of a longer wave-length than that to which the emulsion was originally sensitive, since the smaller grains give steeper gradation than the larger and become more highly sensitive in consequence of the increased dye absorption

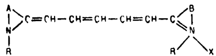
Bancroft, Sheppard and many others have put forward a number of theories to account for the phenomenon of colour sensitising, and we have still almost everything to learn about its mechanism, but a good deal of recent work is likely to go far to clear up the chemistry of the dyestuffs employed We can classify these into a number of chemical groups, and can generally say which particular compounds are likely to sensitise and which are not, from a consideration of their constitution ; we can forecast with fair accuracy the region over which they are going to sensitise the emulsion, and in some cases foretell whether they will be weak or powerful sensitisers In the older days, erythrosine was almost the only dye used, and sensitised the emulsion up to about λ5800, but with the advent of the cyanine group of dyestuffs, great progress has been made and it is now possible to sensitise an emulsion, at will, to almost any part of the visible spectrum This class may be thus represented .



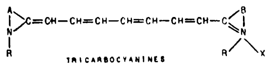
CYANINES



CARBOCYANINES



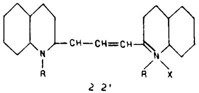
DICARBOCYANINES



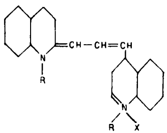
TRICARBOCYANINES

A and *B* represent several types of nuclei and the compound may be unsymmetrical when *A* and *B* are different nuclei The number of CH groups is odd *R* may be methyl, ethyl, allyl, etc , and *X* may be chloride, bromide, iodide, *p*-toluene sulphonate, etc Substitution may also take place in the chain, where one of the CH groups may be replaced by an alkyl, aryl, ethylene or phenylene group, or there may even be a halogen substituent in the chain Generally speaking, as one increases the chain length, the dye becomes more unstable and the photographic products prepared with it more unstable As the length of the chain is increased, the dye absorption and sensitising power travel towards the red end of the spectrum, each additional pair of CH groups moving the absorption by about 1100 A towards the red end of the spectrum

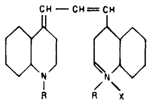
The case of the three carbocyanines with the following formulæ is of interest



2 2′
PINACYANOL



2′4′
DICYANINE



4:4′
KRYPTOCYANINE

The sensitising chain is from the nitrogen in one nucleus to the nitrogen in the second nucleus Hence, the three isomers, the 2 2′, the 2 4′ and the 4 : 4′ compounds, sensitise progressively farther into the red

Many photographic research laboratories are actively at work on the production of new sensitising dyestuffs, since the use of colour sensitive emulsions is varied and important Competition in the photographic industry is very keen and considerable progress has been made in recent years, but in many branches empiricism is still much in advance of proven theory

Electrical Developments in the Soviet Union

THE growth in the use of electrical energy in the Soviet Union in connexion with the Government's industrial development schemes were outlined in a paper read to the Institution of Electrical Engineers by Mr Allan Monkhouse on January 10 He gave interesting details also of the development in the use of peat fuel in large power stations. The first State-planning organisation set up by the Government was the State commission for the electrification of Russia appointed in 1921 In forming this commission, Lenin emphasised the necessity of providing an abundant supply of cheap electrical power as a basis on which industry could develop From 1923 onwards the construction of fifty-six large power stations and the erection of 8,000 miles of high-tension overhead wires with all their distributing substations has been a most spectacular development The rapid growth in the use of electrical power during the last ten years is shown by the increase in the monthly winter output, from 750 million units to 11,000 million units

The industrial districts of the north, which comprise Leningrad, Moscow, the cotton manufacturing district centred at Ivanovo Vosnesensk and the Gorki (Nijni Novgorod) district, where many large engineering works are being constructed, are far removed from the bituminous and anthracite coalfields of the Ukraine or the oilfields situated on the shores of the Caspian Sea For economic and strategic reasons, it was considered necessary to make the northern industrial areas independent of these fuel supplies. Special attention was therefore concentrated on the development of stations burning peat and brown coal.

A survey of the peat areas of the U S.S R indicates that approximately 42 per cent of the world's peat resources are located in that country. It is calculated that 30,460 million tons of fuel are available south of lat. 60° N North of this line, the vast peat resources of the tundra have as yet only been partially surveyed. Using a special form of shaft-chain grate, it was found that the efficiency obtained was quite satisfactory The Balakna power station in the Nijni Novgorod district is the largest peat-burning power station in the world. Its present capacity of 158,000 kw. is being increased to 204,000 kw. Of the eighty-one official stations, approximately 30 per cent operate on peat fuel. A special process of peat-winning known as the hydro-peat process has been developed. The peat is dislodged from the bog with a high-pressure sluicing apparatus, and the mixture of peat and water is then pumped into specially prepared drying fields. After a few days' drying, a special form of tractor with cutter wheels is driven over the field and leaves the peat in such a form that it can be raked up easily and finally air-dried The shortcomings found initially in using peat in a power station have been in large measure overcome, mainly by experimental research

In the Ukraine and the mining districts of the Don basin, much work has been done in utilising the anthracite-waste spoil-banks, which have accumulated over a period of many years, but the efficiencies obtained have been rather disappointing

Large areas of the cities of Moscow and Leningrad are already heated with hot water circulated from the central power stations On the outskirts of these cities, large new so-called thermal-electric stations are being built for heating the new residential districts In Moscow the hot water leaves the water-heating plant in the central power station at a temperature, varying according to conditions, of between 85° and 120° C, and after making a circuit of some two miles, it returns at a temperature of 30°–35° C The pipes are laid in special conduits in the street and are covered with thermal insulation Many of the large new industrial towns are being built with the idea of all their buildings being heated from central thermal-electric power stations.

With the exception of the Ural Mountains and the Caucasus, both of which are far removed from the central industrial areas, there is not enough mountainous country to make high-head hydro-electric power stations possible But the Soviet Government has decided to build a series of large low-head hydro-electric stations on the great rivers of European Russia The dam built on the Dnieper and those being built on the Volga and the Svir have a twofold object in view, namely, providing cheap electric power and making the rivers navigable for large vessels Of the low-head stations, that on the Dnieper is the most important The pressure of transmission is 161 kilovolts, and the station supplies the works of the Dnieper Combine and the central Ukrainian network

A most important undertaking in Central Asia is the Chirchick fertiliser works, designed to produce large quantities of nitrate fertiliser for the cotton fields of Central Asia. The first station has been begun and the turbines will work with a head of 66 metres. The scheme provides for irrigating 1,250,000 acres of cotton growing land. It is interesting to notice that the Soviet authorities have called in Italian consulting engineers to lay out the hydro-electric part of this great scheme.

Some progress has been made in standardising methods The line linking the new Svir hydro-electric station with Leningrad uses the very high voltage of 220 kilovolts The Soviet intends to electrify about 2,300 miles of railway before 1937 The pressure of 1,500 volt direct current is generally used for suburban electrification, but the voltage for the long distance main lines has not yet been fixed

Mr Monkhouse laid stress on the extreme importance the Soviet authorities attach to research and experimental work Academic and fundamental research work is receiving the closest attention, and very large electrical research laboratories have been developed All the various works and factories connected with the Electrotechnical Trust send their more complicated problems to the Central Institute in Moscow The laboratories employ 1,700 workers, about 800 of whom are men with university training The departmental chiefs are, almost without exception, men who occupy professorial chairs in the universities There is little doubt that, in electrical development, more has been achieved than in many other branches of the country's economic life

News and Views

"Letters to the Editor"

On two occasions last year, issues of NATURE were published in which "Letters to the Editor" occupied considerably more than the usual proportion of the journal This week we are printing a Supplement of sixteen pages, fifteen of which are occupied by correspondence—and there are still many letters in type awaiting publication The number of letters we receive for this part of the journal reflects fairly accurately, we believe, contemporary progress of research in all departments of science Last year we printed no less than 597 columns of correspondence, the great majority of which announced new lines of work or made significant contributions to older established knowledge The addresses at the ends of the letters in this week's Supplement alone indicate the world-wide distribution of our correspondents The spate of letters brings its own difficulties, and we are frequently obliged to ask correspondents to reduce the length of communications, but nevertheless we are gratified to find our columns so much in demand. It reaffirms the old saying that science over rides all national barriers Recently, a short section has been introduced at the end of "Letters to the Editor", in which brief mention is made of points brought out in some of the longer letters in the preceding pages. Correspondents will realise the difficulties involved in obtaining suitable notes, and they are invited to submit paragraphs about fifty words in length which they regard as summarising the main conclusions of their communications, for possible use in this section of the journal when their letters appear

Royal Astronomical Society's Medal Awards

The Gold Medal of the Royal Astronomical Society has been awarded to Prof E A Milne, Rouse Ball professor of mathematics, University of Oxford, for his work on radiative equilibrium and theory of stellar atmospheres A Jackson Gwilt (bronze) Medal has been awarded to Mr Walter Frederick Gale, of Waverley, N S W , for his discoveries of comets and his work for astronomy in New South Wales Prof Milne has occupied his present chair since 1929, having then moved to Oxford from Manchester, where he had been professor of applied mathematics Before going to Manchester, however, he was university lecturer in astrophysics at Cambridge and assistant director of the Solar Physics Observatory His contributions to mathematical physics and astrophysics are of particular value on account of the close contacts they represent between observational work and theoretical conceptions His essay as Smith's prizeman at Cambridge in 1922 embodied a treatment of radiative equilibrium which has proved the starting point for the greater part of the more recent work on stellar atmospheres In his Bakerian lecture of the Royal Society in 1929, on the opacity of stellar atmospheres, Prof Milne further developed a method of determining stellar temperatures and pressures, depending largely on the study of the contours of spectrum lines, that is, on the determination of their intensities at different distances from the centre of the lines Of a different character is the model of the universe conceived by Prof Milne and developed in a lecture entitled "World-Gravitation by Kinematic Methods" delivered before the London Mathematical Society in May last The striking simplicity of the method used in the construction of this statistical model, and the far-reaching character of its interpretations, open up a new vista of possibilities for cosmic research

Mr Gale, the Jackson Gwilt medallist of the Royal Astronomical Society, belongs to the enthusiastic band of non-professional, or amateur, astronomers who have contributed so much to observational astronomy He is the discoverer of three comets—in 1894, 1912 and 1927—and has given close attention to the planet Mars, especially during the southern oppositions of 1892, 1894 and 1907. As first secretary, and afterwards president, of the New South Wales branch of the British Astronomical Association, Mr Gale has done much to encourage the practical study of the heavens in New South Wales, as well as to promote interest in astronomy among the general public

Geological Society's Awards

The Geological Society of London has this year made the following awards: Wollaston Medal to

(*Continued on p* 111)

Supplement to NATURE

No 3403 JANUARY 19, 1935

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 110

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

α-β Intramolecular Transformation of Myosin

SHORTLY after the discovery and investigation by the methods of X ray analysis[1] of the long range elastic, intramolecular transformation which takes place when the fibre substance (keratin) of hair is stretched, the possibility emerged that the elastic mechanism of muscle is similar at least in principle to that of hair[2] There is a remarkable likeness between the X ray photograph of washed and dried muscle and that of unstretched hair (α keratin), and there are, moreover, certain striking analogies between their respective elastic properties Recently, the X ray and elastic comparison between muscle and hair has been set out in detail[3], and once more the suggestion was made that the normal molecular configuration of the muscle protein myosin—first shown by Boehm and Weber[4] to give, when oriented, an X-ray photograph resembling* that of muscle itself—is that of a folded polypeptide chain system like that of α keratin, which it should be possible, by extension under appropriate conditions, to transform into a fully-extended system like that of β-keratin (stretched hair). The present writers tried to bring about this transformation two years ago by experiments on the sartorius muscle of the frog, but without success[2]

We have succeeded now in demonstrating the predicted intramolecular transformation by working with the isolated muscle protein instead of with the actual muscle We have found air-dried myosin films to have the following properties · (1) as in gelatin films, the molecular chains lie roughly parallel to the surface ; (2) on moistening with water and stretching, these chains are first pulled into approximate parallelism with the direction of stretching and give rise to an X-ray photograph resembling that of muscle or α keratin , (3) on further stretching, a new photograph appears which closely resembles that of β-keratin , (4) on exposing the stretched film for a few seconds to steam, the β photograph is 'set' and intensified at the expense of the α-, exactly as in the case of stretched hair , (5) myosin films can generally be stretched in cold water to about three times their original length and, like keratin fibres, show well marked long-range reversible elasticity, the β-photograph disappearing again on contraction provided the film has not been kept stretched in the dry state , (6) when myosin films are made by squeezing the re-moistened protein between glass plates, the β-photograph is again observed, but this time with the 'side-chain spacing' normal and the 'backbone spacing' parallel to the flat surface, just as when keratin is squeezed laterally in the presence of steam[5] , (7) *unstretched* myosin film, when exposed for a few minutes to steam, contracts spontaneously by about 20 per cent (artificial muscle !), exactly as does keratin that has been brought into the labile state by the action of X rays on the α-form or by the limited action of steam on the β-form[6].

In brief, myosin films are amazingly similar to the labile, or super-contracting, form of keratin which is produced by the breakdown or modification of certain cross-linkages , and in this comparison the normal contraction of muscle corresponds to the super-contraction of hair[3]. Only very imperfect chemical analyses of myosin and muscle are available—and here the physicist is in very urgent need of help—but, *if we except cystine*, the general distribution of amino-acid types appears to be similar to what has been found for keratin Does this mean that the method of formation of hair is fundamentally similar to that of muscle, except that the elastic system of hair is more or less stabilised and de-sensitised by the incorporation of relatively large amounts of cystine ? In other words, are we to conclude that the hair protein is roughly speaking no other than 'vulcanised' muscle protein ?

The investigation is being continued in order to try to find out the exact relations between the X ray photographs and elastic properties of muscle, myosin, and keratin We wish to express our indebtedness to the Rockefeller Foundation for financing the research, to the superintendent of the Cambridge Low Temperature Research Station for his kind co-operation, and to Dr E C Smith of that laboratory for the invaluable supplies of fresh myosin which have so far formed our exclusive experimental material[7]

W T ASTBURY
SYLVIA DICKINSON

Textile Physics Laboratory,
University of Leeds
Jan 7

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* Boehm and Weber claim that the two photographs are indistinguishable, but this is at least doubtful until much more perfect photographs are available It may be said with equal justification that the photograph of hair is also almost the same as that of myosin.

[1] W T Astbury and A Street, *Phil Trans Roy Soc* , A, **230**, 75 , 1931 W T Astbury and H J Woods, NATURE, **126**, 913 , 1930 *Phil. Trans* , A, **232**, 333 , 1933

[2] W T. Astbury, *Trans Faraday Soc* , **29**, 193 , 1933

[3] W T Astbury, "X-Ray Studies of Protein Structure", Cold Spring Harbor Symposia on Quantitative Biology, **2**, 15 , 1934 , and "Röntgenoskopie von Proteinfasern", *Koll Z* , **69**, 340 , 1934

[4] G Boehm and H H Weber, *Koll Z* , **61**, 269 , 1932

[5] W T Astbury and W A Sisson, *Roy Soc* —in press

[6] W T Astbury and H J Woods, *Phil Trans Roy Soc* , A, **232**, 333 , 1933 H J. Woods, NATURE, **132**, 709 , 1933

[7] E C Smith, *Proc Roy Soc* , B, **105**, 579 , 1930 **114**, 494 , 1934.

Natural and Artificial Radioactivity of Potassium

THE question of the origin of the radioactivity of potassium has been much discussed in recent years[1] The possibility, however, of producing new radioactive isotopes artificially has opened up a new line of attack on this problem Quite recently Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti and Segrè[2] have found that, by bombardment of potassium with neutrons, a new radioactive isotope of potassium is produced having a period of 16 hours Potassium having two stable isotopes, 39 and 41, it is not possible to draw conclusions from these experiments on the mass of the new isotope The problem can be settled, however, from the fact that the new isotope of potassium can also be produced by bombarding scandium with neutrons By experiments in this laboratory in which I have been kindly assisted by Hr Høffer Jensen, we find that scandium can be converted into a radioactive isotope of potassium As scandium has only one isotope (45) this conversion must take place according to the equation

$$_{21}Sc^{45} + {}_0n^1 \longrightarrow {}_{19}K^{42} + {}_2\alpha^4.$$

As the potassium obtained by us has the same period as that found by the Italian workers, we have to conclude that in their experiments it was K^{41} which captured a neutron and was converted into K^{42} In our experiments we bombarded scandium oxide with neutrons produced by a mixture of beryllium and radium emanation, thus applying Fermi's beautiful method The scandium oxide was dissolved in hydrochloric acid and, after the addition of 0 15 gm of sodium chloride and the same amount of calcium chloride, precipitated with ammonia The calcium present in the filtrate was removed as oxalate and found to be inactive The remaining sodium chloride, however, was found to be active and to contain the potassium isotopes looked for This decayed with a period of about 16 hours, emitting very hard β rays of approximately 1 2 million e v

From my comparison of the radioactivity and the atomic weight of potassium fractions obtained by distillation processes (partial separation of isotopes), it follows that the mass of the isotope to which the natural radioactivity of potassium is due can only be 40, 41 or 42 The first mentioned figure is obtained if we accept Baxter's analysis of the fractions, while that of Hönigschmid is only compatible with 41 and 42 Knowing now that the isotope 42 has a short life (16 hours) we are restricted to the alternative 40 or 41

From measurements with the mass-spectrograph, we know that K^{41} is present in potassium in the extent of 7 per cent From this figure and the number of β-particles emitted per second by 1 gm of potassium, it follows that, if the natural radioactivity of potassium is due to K^{41}, it has a period of 10^{12} years The hypothetical isotope K^{40} should have a much shorter life as this isotope has not been revealed by measurements by the mass spectrograph From this fact the upper limit of its period can be stated to be 5×10^{10} years A lower limit, 10^{8} years, is given by the calcium content, potassium content and geological age of old minerals Presumably when potassium is bombarded by neutrons, K^{39} captures neutrons as well, but since the resulting K^{40} has a long life, its formation cannot be established through measurements of induced activity

The great difficulty for the theory of β-ray emission, arising from the fact that potassium, in spite of its very long life, emits fairly hard β-rays of a mean energy of about 5×10^{5} e v, has been discussed repeatedly The discrepancies between theory and experiment would be somewhat lessened if it could be shown that the natural radioactivity of potassium is due to K^{40}, but this difficulty would still remain It is of interest to note in this connexion that the artificially produced isotope of potassium 42, though having a similar period to thorium B, emits β rays of more than ten times greater mean energy than the latter Also, the nucleus of this potassium isotope is thus emitting much harder rays than members of the radioactive disintegration series of similar period

G HEVESY

Institute for Theoretical Physics,
Copenhagen Dec 23

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[1] cf G Hevesy, M Pahl and R Hosemann, NATURE, **134**, 377 Sept 8, 1934

[2] *Ricerca Scientifica*, **2**, December 1934

Absorption of Cosmic Particles in Copper and Lead

BY the method of the coincidences between three Geiger-Muller counters of 2 5 cm diameter and 25 cm effective length, disposed as in Fig 1, I have carried out comparative measurements of absorption of the hard component of cosmic particles in copper (atomic weight $(A) = 63\ 57$, atomic number $(Z) = 29$) and in lead ($A = 207{\cdot}20$, $Z = 82$) Lead screens (altogether 9 cm) were arranged permanently between the counters, in order to exclude softer particles

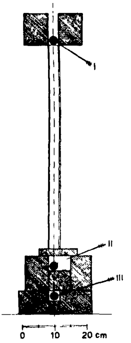

FIG 1

The absorbing screens, made of bars of surface area 2 5 cm × 30 cm, were interposed between the first and second counter, they had the same mass per cm² of 575 gm/cm.², the bars of lead were arranged in such a way as to occupy altogether the same height as the copper screen

The triple coincidences were recorded by an automatic device[1], the resolving power of which, determined according to the double chance-coincidences, was 6×10^{-4} sec with this resolving power the expected number of triple chance-coincidences is 0 08 an hour.

The results given in Table 1 were obtained by alternating regularly the measurements taken without absorbing screen between the counters with those taken with the screens of copper and lead.

In the course of these measurements, the triple coincidences with the middle counter displaced laterally 3 2 cm were also recorded in order to test the reliability of the method Table II shows that not more than about a tenth of coincidences observed in the preceding case can be attributed to primary particles scattered by the screens or to secondary ones generated near the counters.

From the results reported in Table I there does not appear to be any difference, within the limit of experimental errors, between the absorption of cosmic particles filtered through 9 cm of lead, in copper and lead, the mass per cm.^{2} of the screens being equal. This absorption in 575 gm /cm ^{2} is (37 6 ± 3 2) per cent.

TABLE I Counters in line

	Permanent screen of 9 cm of lead	Copper (575 gm./cm ^{2})	Lead (575 gm /cm ^{2})
Time observation (hours)	300 00	300 00	300 00
Triple coincidences observed	962	608	601
Triple coincidences per hour	3 206 ± 0 103	2 002 ± 0·082	2 000 ± 0 081

If the absorption were proportional to the number of electrons per cm ^{2}, the values of the absorption for the two screens of equal mass per cm ^{2} should be in the ratio of $(Z/A)_{\mathrm{Cu}}/(Z/A)_{\mathrm{Pb}} = 0\ 87$; that is, a difference of 13 per cent would be expected The measurements reported (as, indeed, others carried out on the absorption of particles of lower range[2]) do not reveal such difference it appears therefore that the absorption may be rather connected with the mass per cm ^{2} than with the number of electrons per cm ^{2}· however, the statistical error of measurements, which amount to 8 83 per cent in comparison between the absorption of copper and lead, does not make this quite certain

TABLE II Middle counter displaced

	Permanent screen of 9 cm of lead	Copper (575 gm /cm ^{2})	Lead (575 gm /cm ^{2})
Time of observation (hours)	100 00	103 93	101 62
Triple coincidences observed	42	26	22
Triple coincidences per hour	0 420 ± 0 066	0 250 ± 0 049	0 217 ± 0 046

What is certain, however, is that there does not exist for the absorption of the cosmic particles any marked dependence on the atomic number of the absorbing screen of the kind of that which has been found[3] for the absorption of the shower-producing radiation

I beg to express my thanks to Prof. B. Rossi, who advised me to make this research.

GIULIA ALOCCO.

Physical Institute,
University, Padua.
Dec. 1.

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[1] B Rossi, *Ricerca Scientifica*, V, 2, 561 , 1934

[2] G Alocco, *Ricerca Scientifica*, V, 2, 91 , 1934

[3] B Rossi, NATURE, 132, 173 , 1933

Terrestrial Magnetism and Cosmic Rays

IT has been shown by several observers within the last few years that the ionisation caused by cosmic radiation, when reduced to the same barometric pressure, is not constant In addition to a very small regular diurnal variation, the existence of which has been proved by continuous registration over a period of three years at 2,300 metres above sea-level[1], much larger and irregular variations have been found by different observers ("Schwankungen zweiter Art", as they were termed by A. Corlin). These are clearly perceivable when, for example, hourly observations of the cosmic ray intensity (or even the daily mean values) are reduced to standard pressure. At the Hafelekar Observatory in the Tyrolean Alps (2,300 m.) the daily average intensities may differ by so much as 0 10 *J* , that is, by 4 per cent (total ionisation with complete lead screen 10 cm. thick on all sides of the apparatus amounting to about 2·80 *J*) With apparatus unscreened from above, even larger variations may occur

The so-called latitude effect of the cosmic radiation suggests a possible explanation of these irregular 'variations of the second kind', for W. Messerschmidt[2] has found that these irregular variations, as observed in a three-month series by the Hoffmann standard apparatus in Halle (Germany), were related to simultaneous variations of the horizontal intensity of the terrestrial magnetic field , a decrease of the latter seemed to cause an increase of the daily average cosmic ray ionisation, and vice versa

We thought it worth while to investigate whether a similar relationship holds also in our observations at the Hafelekar In order to eliminate the influence of the regular daily variations, we calculated the average cosmic ray intensity for each day of the year 1933 on which at least eighteen hourly observations were registered Our observations were carried out partly with a lead screen of 10 cm thickness on all sides of the apparatus, and partly with the screen underneath and on the sides but not on top The former were made as a rule from the 1st to the 10th and from the 21st to the end of each month, the latter from the 11th to the 20th, according to an agreement with several colleagues abroad who were taking similar observations of the cosmic ray intensity in different places, ranging from lat. 68° N to lat. 35° S.

The mean horizontal intensity *H* of terrestrial magnetism was calculated for each day from registrations of the Terrestrial Magnetic Station, Vienna-Auhof, by the formula

$$H = \frac{1}{24}\left(h_0 + 2h_2 + 2h_4 + 2h_6 + \ . \ . \ . \ + h_{24}\right),$$

where h_0, h_2, etc , denote the observed magnetic intensities at 0^h, 2^h, 4^h, etc These data were kindly placed at our disposal by Prof Wilhelm Schmidt, director of the Meteorologische Zentralanstalt, Vienna

Diagrams were then drawn for each 10-day and 20-day interval, showing the variations of the cosmic ray intensity (*a*) with complete screening (10 cm lead on all sides), and (*b*) with no lead on top of the apparatus, with the variations of the average horizontal magnetic force from day to day The latter varied between 20,470 γ and 20,530 γ, while the maximum of the cosmic ray fluctuation in case (*a*) amounted to about ± 0·05 *J*. (average 2·80 *J*.), in case (*b*) to ± 0·06 *J*. (average 4·6 *J*.), in the course of one year.

From the diagrams we were unable to obtain unambiguous evidence of any connexion between the variations of the horizontal component of the earth's magnetic field and of the cosmic ray intensity. There were even periods of several days in which an increase of the horizontal magnetic intensity was accompanied by an increase of the ionisation of the cosmic rays.

We therefore thought it best to calculate the correlation coefficients (*r*) between the daily means of the cosmic ray ionisation and the horizontal magnetic intensity This was done using Charlier's method[3] Taking all observations of the year 1933 (eleven months, since in April no observations were taken) we obtained the following values

Case (*a*) (10 cm lead screen on all sides)	$r = 0.12$	(January to December 1933)
Case (*b*) (no lead screen on top of apparatus)	$r = -0.28$	

The negative values of r indicate that, on the whole, an anti-parallelism between the two magnitudes does exist, in concordance to W Messerschmidt's results. The numerical values of r are very low, therefore we must conclude that the relationship is rather slight

It is remarkable, however, that if we exclude the first three months of 1933, in which several slight alterations of our Steinke apparatus had to be made, we obtain a much better correlation

Case (*a*) (10 cm lead on all sides)	$r = 0.19$	(May to December 1933)
Case (*b*) (no lead screen on top of apparatus)	$r = 0.57$	

The correlation in case (*b*) is very good, thus indicating that the soft components of the cosmic radiation entering the apparatus when it is not screened from above are more influenced by variations of the horizontal intensity, and this is what is to be expected

We conclude that our observations indicate that the so-called 'variations of the second kind' of the cosmic radiation are partly due to variations in the opposite sense of the horizontal component of the earth's magnetic field

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[2] W Messerschmidt, *Z Phys*, **85**, 332, 1933

[3] C V L Charlier, "Vorlesungen über die Grundlagen der mathematischen Statistik", Verlag Scientia, Lund, 1920, chap xiv (Class-Method)

Radioactivity of Potassium

FERMI failed to detect induced β-radioactivity with calcium bombarded by neutrons, and this fact has been attributed[1] to the existence of a closed neutron shell in the calcium nucleus. We suggest alternatively that the failure to detect radioactivity may constitute a proof that the source of the natural radioactivity of potassium is the isotope $_{19}\mathrm{K}^{40}$ of such small abundance that it cannot be detected by means of the mass-spectrograph

Aston's work indicates that $_{20}\mathrm{Ca}^{40}$ is by far the most abundant calcium isotope, the ratio of $_{20}\mathrm{Ca}^{40}$ to $_{20}\mathrm{Ca}^{44}$ being 70 to 1, the other isotopes of mass number 42 and 43 being present in very small amounts. Thus by far the greater number of neutrons will interact with $_{20}\mathrm{Ca}^{40}$ and it seems reasonable, therefore, to suggest that any radioactivity induced in isotopes other than $_{20}\mathrm{Ca}^{40}$ will be too slight to be detectable. In addition, Fermi has definitely detected proton emission following neutron capture with $_{12}\mathrm{Mg}^{24}$, $_{13}\mathrm{Al}^{27}$, $_{14}\mathrm{Si}^{28}$, $_{15}\mathrm{P}^{31}$, $_{16}\mathrm{S}^{32}$, $_{24}\mathrm{Cr}^{52}$ and $_{30}\mathrm{Zn}^{64}$, and of these seven isotopes five have even atomic number It therefore appears likely that the following reaction occurs when calcium is bombarded with neutrons

$$_{20}\mathrm{Ca}^{40} + n \rightarrow {}_{19}\mathrm{K}^{40} + p\uparrow .$$

As a result of such an action, only a very small number of radioactive potassium nuclei could be produced, and assuming $_{19}\mathrm{K}^{40}$ is the source of the natural radioactivity of potassium, the long life of this isotope explains why no disintegrating electrons were observed

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[1] Wenli Yeh, *C R*, **199**, 1209, 1934

Radioactivity Induced by Neutrons

AMALDI, d'Agostino and Segrè[1] report that, using neutrons from a radon - alpha particle - beryllium source, they have induced an activity in indium of a very short half-life period (13 sec) and also one of half-life period of about one hour (54 min)

Our own unpublished observations on indium show the one hour period and a longer period of several hours (estimated at 3½ h). If indium is irradiated in air these two periods show strong initial intensities of the same order of magnitude, but if it is irradiated in water, the one hour period is so strongly reinforced that it overshadows the long period and may thereby prevent its detection Thus three periods appear to exist for indium, and the two shorter ones of these are reported[2] to be strongly water sensitive

Indium has two known isotopes[3] (mass numbers 113 and 115, the ratio of their abundance being less than one to ten). It has an odd atomic number and since, apart from the isolated case of hydrogen, there is no precedent for such an element having more than two isotopes, we tentatively assume that no further stable indium isotope is involved. Accordingly we conclude that one of the two indium isotopes is activated with more than one period

The question arises whether the observed periods can be interpreted on the basis of the primary processes which have so far been recognised in the Fermi effect. These recognised processes are (*a*) capture of the neutron by the nucleus (all cases so far investigated were reported to be water-sensitive), (*b*) ejection of a heavy positively charged particle—a proton or an alpha particle—from the nucleus (all cases so far investigated were reported not to be water-sensitive) Some isotopes of lighter elements are known to be activated with two or three periods, the ejection of a proton or an alpha particle being quite a common process for elements lighter than zinc (atomic number 30) No such processes have so far been observed for elements heavier than zinc.

In the circumstances the Fermi effect of indium (atomic number 49) seems to deserve further investigation, for which adequate instruments of observation are not at present at our disposal.

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[1] Amaldi, d'Agostino, Segrè, *Ricerca Scientifica*, V, **2**, No 9-10 November 1934.

[2] Amaldi, d'Agostino Fermi, Pontecorvo, Rasetti, Segrè, *Ricerca Scientifica*, V, **2**, No 11-12, December 1934.

[3] Wehrli, *Helvetica Physica Acta*, **7**, 6, 611; 1934.

Induced Radioactivity produced by Neutrons liberated from Heavy Water by Radium Gamma-Rays

WORKING in this laboratory, Szilard and Chalmers[1] have shown that neutrons are liberated from beryllium irradiated by radium gamma-rays, and that they are capable of inducing radioactivity in a number of elements. Previously, Chadwick and Goldhaber[2] had reported that, using an ionisation method, they had observed the liberation of protons from heavy hydrogen which was irradiated by gamma rays from thorium C.

In the light of these observations, and having regard to possible biological applications of heavy water, it is of interest to determine whether the neutrons presumed to be liberated by the gamma-ray disintegration of heavy hydrogen can activate other elements.

We have succeeded in observing the radioactivation of iodine and bromine which had been bombarded by the neutrons liberated from heavy water irradiated by radium gamma-rays. In one series of experiments we used 10 c.c. of heavy water of 30 per cent concentration, and irradiated it with gamma-rays from 150 mgm. of radium filtered by 1 mm. of platinum. The heavy water almost completely filled the space between the double walls of a glass container similar in construction to a diminutive cylindrical Dewar vessel. The radium occupied the central cavity of the container, which was immersed in 400 c.c. of ethyl iodide.

After irradiation, the radio-iodine was precipitated and removed from the ethyl iodide by the method of isotopic separation described by Szilard and Chalmers[3], and its activity measured on a Geiger-Muller β-ray counter. Using the quantities above mentioned, the counter recorded an average of 110 impulses in 5 minutes, whereas the control experiments carried out with 10 c.c. of ordinary water contained in a duplicate vessel gave 55 impulses against a normal 'background' of 30-35 impulses in 5 minutes. We attribute the difference in count between the normal 'background' and the control experiments with ordinary water to primary neutrons emitted by the source.

A similar series of experiments, in which 300 c.c. of bromoform was substituted for the ethyl iodide, gave strictly comparable results with radio-bromine to those obtained with radio-iodine. We conclude that neutrons emitted from heavy water irradiated by radium gamma-rays are capable of inducing radioactivity in iodine.

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[1] NATURE, 134, 494, Sept. 29, 1934.
[2] NATURE, 134, 237, Aug. 18, 1934.
[3] NATURE, 134, 462, Sept. 22, 1934.

Spectrum of Ordinary Hydrogen (H_2)

I HAVE recently found several systems of bands in which the electronic transitions are from new upper states of H_2 down to the singlet state generally denoted by ${}^1X$. These band systems are of importance and interest for a variety of reasons.

I gather that there is no general agreement as to what the electronic configuration of the final state ${}^1X$ is, but I have put forward what I believe strong reasons for thinking it to be the $1s\sigma 2s\sigma {}^1\Sigma_g$ state which otherwise would, quite unaccountably, be missing. Hitherto, our knowledge of ${}^1X$, derived from the analysis of the ${}^1X \rightarrow 2p{}^1\Sigma$ system, has been very meagre except at the vibrational levels $v = 1$ and 2. These levels have a very irregular rotational structure and so also had the $v = 3$ level according to the old analysis.

This has generally been supposed to be due to uncoupling, which is impossible if the state is $1s\sigma 2s\sigma {}^1\Sigma$, or to some other type of perturbation. I have recently repeated the former analysis of the ${}^1X \rightarrow 2p{}^1\Sigma$ system and have found an error at the $v' = 3$ level and some new lines. These changes make the rotational structure of the $v' = 3$ level quite regular as H_2 levels go. As a result of the analysis of the new systems ending on ${}^1X$, I have found what I believe to be the $v = 0$ level of this state. It has a quite regular rotational structure and is about what one would expect *a priori* for $1s\sigma 2s\sigma {}^1\Sigma$, so that the most serious objection to the identification of ${}^1X$ with $1s\sigma 2s\sigma {}^1\Sigma$ has now disappeared. The cause of the rotational irregularity at the $v = 2$ and 3 levels is still a mystery. The difficulty about attributing it to a perturbation is that there is no known state, and so far as can be foreseen no possible state, which could be in the position and have the other properties theoretically necessary to cause a perturbation.

The strength of the new systems, which are weak, lies mainly along the diagonal axis in each case. So far, three systems seem to have emerged definitely, but there are indications of the existence of others. The upper states of the three I call provisionally ${}^1D$, ${}^1R$ and ${}^1U$. The analysis of these has gone far enough to enable some definite, though preliminary, statements to be made about them.

The system ${}^1D \rightarrow {}^1X$ lies in the infra-red around 8000 A. I believe that the upper state ${}^1D$ is the same as the D state of Hopfield, to which he found strong transitions up from the ground state in the absorption spectrum of H_2. At least if my interpretation[1] of Hopfield's data be accepted, they lie close together and have similar properties. An analysis of the $v = 2$ and 3 levels of ${}^1D$ (I have not yet found the $v = 0$ level and the $v = 1$ level is not very secure) gives the following approximate electronic constants: ν_e (depth from the ground level of the molecular ion) 11267 wave numbers, Rydberg denominator 3·12, fundamental frequency (ω_0) 2300 wave numbers. The corresponding quantities for Hopfield's D state which I derived from his absorption data are: ν_e 11560, *R.d.* 3·08, ω_0 2257, $x\omega_0$ 59·5. These data also involve an extrapolation from higher but different vibrational levels down to the $v = 0$ level, so that exact agreement is not to be expected. I think that ${}^1D$ is $1s\sigma 3p\pi {}^1\Pi_u$, but the possibility that it might be $1s\sigma 3p\sigma {}^1\Sigma_u$ is not yet absolutely excluded.

The system ${}^1R \rightarrow {}^1X$ lies around λ5900 A. The ν_e of ${}^1R$ is about 6400 giving a denominator of 4·14, ω_0 is about 2230 and $x\omega_0$ about 60. I think ${}^1R$ is $1s\sigma 4p\pi {}^1\Pi_u$, but here again $1s\sigma 4p\sigma {}^1\Sigma_u$ is also possible. ${}^1U \rightarrow {}^1X$ lies around λ5400 A. The approximate numerical data for ${}^1U$ are $\nu_e = 4900$ wave numbers, *R.d.* = 4·74, ω_0 about 2220 and $x\omega_0$ about 45. I think this state is most likely to be $1s\sigma 5p\sigma {}^1\Sigma_u$, but there are some lines about which look like Q branches, so it may be a Π state. In that case it may be either $1s\sigma 5p\pi\,^1\Pi_u$ or $1s\sigma 5f\pi\,^1\Pi_u$, but I think it certain that it has one unexcited electron ($1s\sigma$). All the other properties of the new upper states are in agreement with what would be expected for these assignations

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[1] "Molecular Hydrogen and its Spectrum", pp 303 ff.

Fluorescence of Fluorite and the Bivalent Europium Ion

EXPERIMENTS conducted in this Institute[1] had led to the conclusion that the blue fluorescence of fluorite excited by filtered ultra-violet light is due to traces of europium under the influence of radioactive substances, and that a yellow-green fluorescence which some fluorites show at the temperature of liquid air—especially those from acid magmatic rocks—is, in the same way, due to ytterbium As these rare earths are those most readily obtained in the bivalent form[2], as further the reducing action of Becquerel rays is well known, and as the blue fluorescence can also be obtained in CaF_2 containing europium, simply by reduction through heating, the hypothesis was put forward that these broad 'radio-photofluorescence' bands are to be ascribed to the *bivalent* forms of the rare earths

Through the courtesy of Prof G Jantsch, of Graz, we are now able to *prove* this hypothetical assumption in the case of europium Prof Jantsch kindly lent us preparations, made in the Institut für anorgan. chem Technologie und analyt Chemie of the Technische Hochschule, Graz, of pure $SmCl_2$, $SmCl_3$, $EuCl_2$ and $EuCl_3$, of which the last shows, when excited by filtered ultra-violet light, a brilliant purplish pink fluorescence, as already noticed by Prof. Jantsch. Spectrograms of this fluorescence, taken by Miss B. Karlik in this Institute, show *a broad band in the blue, identical with the well-known fluorite band*, and in the red a rather narrow line at 690 mμ, as well as a diffuse band with a maximum at about 630 mμ, which strikingly resembles a red band shown by some fluorites but also by synthetic 'pure' CaF_2 after suitable heat and radium treatment. Whilst there can be no more doubt about the blue fluorite band being due to bivalent europium, the question if the red band in fluorite is also to be attributed to minute traces of this substance must form the subject of further investigations

$EuCl_2$ and $SmCl_2$ show no fluorescence, the latter perhaps because of its deep black colour $SmCl_3$ fluoresces orange[3], with lines at 603·5 and 598·5 mμ It is to be hoped that these observations may also furnish new clues to the atomic structure of the rare earths A detailed report will be presented to the Vienna Academy of Sciences

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[1] H. Haberlandt, B Karlik and K Przibram, *Wien Ber*, IIa, 143, 151, 1934 See also NATURE, 133, 99, 1934

[2] G Jantsch and W Klemm, *Z anorgan Chem*, 216, 80, 1933

[3] For the line-fluorescence of other trivalent rare earth salts, see R. Tomaschek and O Deutschbein, *Phys Z*, 34, 374, 1933 and M Haitinger, *Wien. Ber*, IIa, 142, 339, 1933

Quasi-Crystalline Structure of Liquids and the Raman Effect

IT is known that at the scattering of light in liquids a continuous spectrum appears[1] around the primary line on both sides to a distance of about 15–20 A This effect is usually referred to as 'wings'

These wings are generally ascribed to unresolved rotation Raman lines It seemed to one of us[2] more probable that the appearance of wings is connected not with rotation of molecules but with a new type of frequency change of the scattered light found by one of us[3]. For several years the wing phenomenon has been systematically investigated in our laboratory in various compounds and in different experimental conditions One of us (E G) has investigated the influence of temperature on the wings It might be expected that the raising of temperature would cause a broadening of wings, if they were really due to rotations of the molecules, but no difference could be found in the breadth of wings given by xylene at $t_1 = 15°$ C. and $t_2 = 160°$ C ($T_2/T_1 \approx 1{\cdot}5$) Only a slight increase of the intensity of the wings just near the primary line could be noticed With diphenyl ether, $(C_6H_5)_2O$, which could be heated to 250° C ($T_2/T_1 \approx 2$), we have obtained similar results, the only difference being that the increase of intensity just near the primary line was more pronounced Therefore we can conclude that the wings consist of two different parts behaving differently on heating an inner part (about 20 $cm.^{-1}$) in the closest vicinity of the primary line, and an outer and much greater part The absence of broadening of the second part on heating is opposed to the rotation hypothesis. This part behaves on heating like vibrational Raman lines and could be attributed to the loosely bound vibrations

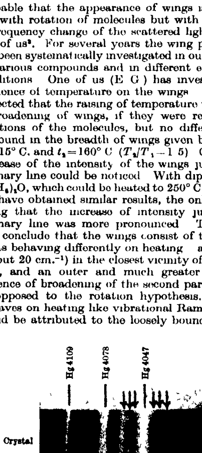

FIG 1 Raman effect of crystalline and liquid diphenyl ether

With the view of putting the vibrational and rotational hypothesis to the test, we have investigated the Raman effect in a crystal of diphenyl ether, and have obtained most interesting results. Instead of wings, we obtained on their position four lines lying on both sides of the primary line (Stokes and anti-Stokes lines). Some of the lines, marked by arrows, are clearly seen in Fig. 1 These lines correspond to infra-red frequencies of $\nu_1 = 21$ $cm.^{-1}$, $\nu_2 = 39$ $cm.^{-1}$, $\nu_3 = 69$ $cm.^{-1}$ and $\nu_4 = 100$ $cm.^{-1}$. These new lines are the vibrational Raman lines and not the rotational ones, for the following reasons :

(1) The distances between the lines are unequal and of different order of magnitude from that determined by the moments of inertia of the diphenyl ether molecule

(2) The intensity of the lines $\nu_1 = 21$ cm $^{-1}$ and $\nu_4 = 100$ cm $^{-1}$ is greater than that of $\nu_2 = 39$ cm $^{-1}$ and $\nu_3 = 69$ cm $^{-1}$ When the crystal is melted, these lines broaden into a continuous spectrum (wings), while other Raman lines do not undergo any marked change It seems, therefore, that we can ascribe the former lines to vibrations characteristic of the crystal lattice and the latter to molecular vibrations The fact that the former lines do not disappear in the liquids shows that apparently some elements of the crystal lattice remain, although deformed, also in the liquid state

A more careful investigation of the Raman spectrum of liquid diphenyl ether showed that a broad diffuse maximum of intensity appears in the region of the wings corresponding to the strong line $\nu = 100$ cm $^{-1}$ in the crystal On raising the temperature to 250° C, this maximum broadened until it could not be noticed against the continuous spectrum of the wings.

All these observations are in good agreement with the theory of the quasi-crystalline structure of liquids often discussed in connexion with the diffraction of X rays[4]

In some degree the appearance of the wings is characteristic for most, if not for all, liquids. There is no reason to expect that in other liquids (such as benzene), this phenomenon has a different origin from that in diphenyl ether Thus, generalising the above results, we may say

(1) The usually accepted explanation of the wings is not correct This phenomenon is principally due not to the rotational but to the vibrational Raman effect A slight asymmetry in the intensity distribution on the red and the violet side[5] as well as the dependence on the primary frequency[6] is easily explained

(2) The part of the wings adjacent to the primary line, which grows in intensity with rising temperature, is probably a prolongation of the continuous spectrum observed[7] between the components of the Rayleigh line by instruments of great resolving power. Perhaps for this part of the wings the rotation hypothesis is valid, though it may be connected also with Debye heat vibrations

(3) Our experiments give new facts in support of the theory of the quasi-crystalline structure of liquids They indicate the possibility of examining this problem by means of the Raman effect

At the present time, detailed investigations of the wings from this new point of view are in progress in our laboratory with different compounds in the liquid, crystal and gaseous states

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[2] E Gross, NATURE, 126, 400, 1930

[3] E Gross, NATURE, 126, 201, 1930. 129, 722; 1932

[4] For example, G W Stewart, *Rev Modern Phys*, 2, 116, 1930

[5] W Gerlach, *Ann Phys.*, 1, 301, 1929

[6] T Weller, *Z. Phys.*, 68, 782, 1931

[7] E. Gross, NATURE, 126, 400, 1930.

Identity of the Growth-Promoting and Root-Forming Substances of Plants

IN a recent brief communication on the chemical nature of the root-forming hormone of plants[1], the following evidence was brought forward

(1) The hormone is an organic acid, dissociation constant about $10^{-4\,5}$, the activity of which is readily destroyed by oxidising agents

(2) The hormone has about the same solubilities in various organic solvents, and distils in the same temperature range *in vacuo*, as the auxin, or growth-promoting hormone, obtained from *Rhizopus suinus*

(3) The crystalline auxin preparations prepared by Kögl and co-workers from urine[2] show root-forming activity, and their activity is destroyed by oxidising agents, when the destruction is partial, the root-forming and growth-promoting activities are destroyed to the same extent

The evidence thus points to the identity of the two hormones, but on account of the inconstancy of the ratio of the two kinds of activities in various preparations and for other reasons, the matter was left open

It has since been found by Kogl, Haagen-Smit and Erxleben[3], that one of the active growth-promoting hormones present in urine is identical with β-indolyl-acetic acid We have, therefore, prepared this substance synthetically, and find it to be fully active in promoting root formation The possibility of an active impurity in the products obtained from natural sources scarcely arises in the case of a pure synthetic compound, and no doubt therefore remains that, of the factors promoting root formation, this one is identical with that which gives rise to growth by cell elongation The pure substance has an activity of from 7 4 to 28 × 10^4 root units per mgm, and a growth-promoting activity of 31 × 10^4 growth-stimulating units per mgm, hence a ratio root units to growth-stimulating of from 0 2 to 0 7 This agrees satisfactorily with the figures previously quoted by us for the crystalline auxins of Kögl and co-workers[1], so that the root-forming activity of these substances could not have been due to traces of impurities either It may be noted that the ratio between our growth units and those of the Utrecht workers, previously deduced on theoretical grounds[4], would give β indolyl-acetic acid an activity of 2 5 × 10^7 *Avena* units (A E) per mgm, compared with 1 to 2 × 10^7 A E per mgm. given by Kögl and co-workers

The fact that two such different functions as the formation of roots on cuttings and the growth of tissues by cell elongation should be brought about by the same specific substance raises interesting questions of mechanism, particularly since all three of the substances are about equally active in both functions.

The homologues of β-indolyl-acetic acid, namely β-indolyl-propionic and indole-β-carboxylic acids, are without activity in root formation, they were correspondingly shown to be inactive in growth promotion by Kögl, Haagen-Smit and Erxleben[3]. Our own preparations and tests confirm the results of the latter workers in respect of growth promotion. Indole itself is also inactive. The propionic derivative, which was a commercial product, showed, even after two recrystallisations, slight growth-promoting activity in concentrated solutions, due doubtless to the persistence of traces of its lower homologue. The activity, which was less than 0·2 per cent of that of β-indolyl-acetic acid, was still further reduced on again recrystallising.

The test for root-forming activity, using pea cuttings, has been described by Went[5] The β indolylacetic acid was prepared by the method of Majima and Hoshino[6]. The indole-β carboxylic acid was prepared by direct combination with carbon dioxide as described by Zatti and Ferratini[7]

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[1] K V Thimann and F W Went, *Proc Kon Akad Wetensch*, Amsterdam, **37**, 456, 1934

[2] *Z physiol Chem*, **214**, 241, 1933

[3] *ibid*, **228**, 104, 1934

[4] K V Thimann and J Bonner, *Proc Roy Soc*, B **113**, 145 1933

[5] *Proc Kon Akad Wetensch*, Amsterdam, **37**, 445, 1934

[6] *Ber*, **58**, 2042, 1925

[7] *Ber*, **23**, 2296, 1890

Starvation and Regenerative Potency in *Dendrocoelum*

THE regenerative potency of Planarians may be depressed in several ways, for example, by irradiation (Wiegand, 1930, and others), or by repeated regeneration of the head-region (10 days after a previous amputation Sivickis, 1931) This has been interpreted by some authors as due to a reduction in the amount of formative material available, by others as due to alterations in the general metabolism of the body and the degree of differentiation of the tissues involved (Sivickis)

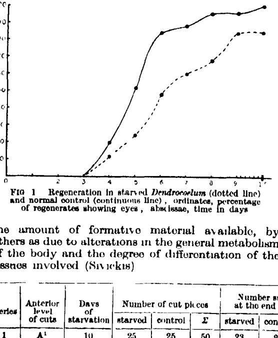

FIG 1 Regeneration in starved *Dendrocoelum* (dotted line) and normal control (continuous line), ordinates, percentage of regenerates showing eyes, abscissae, time in days

Series	Anterior level of cuts	Days of starvation	Number of cut pieces			Number survived at the end of expt			Number of regenerations			Delay in time of completion of regeneration
			starved	control	Σ	starved	control	Σ	starved	control	Σ	
1	A[1]	10	25	25	50	23	22	45	23	22	45	> 24 hours
2.	A[1]	8–10[3]	25	25	50	21	23	44	18	23	41	24 hours
3	B[2]	8–10[3]	25	25	50	16	16	32	14	16	30	> 24 hours
4.	A[1]	20	25	25	50	25	25	50	21	25	46	> 24 hours
Summary			100	100	200	85	86	171	76	86	162	

[1] Closely posterior to eyes [2] Midline between eyes and pharynx [3] Judged only by the colour of the intestine

To test these ideas, experiments were undertaken on the effect of starvation For this purpose, the abundant species *Dendrocoelum lacteum* is very convenient, since the degree of starvation is reflected in the colour of the animals, the dark gut contents showing through the translucent white body

Well-fed stocks of defined degrees of starvation were taken, their heads amputated, and observation continued for 15 days (for details see Sivickis) The appearance of eyes were taken as the criterion of successful regeneration. Four series, differing slightly in detail as to level of cut, degree of starvation and temperature, have given concordant general results, in that the regenerative potency was always lower in the starved stocks, regeneration being delayed, and (in three of the four series) the percentage of non-regenerating specimens increased (see Fig 1 and table) The proportion of non-regenerating specimens for all series was 0 per cent for controls and 10 per cent for the starved stocks, although the mortality rate of the latter was not increased at all

Starvation thus has the same effect on regeneration as radium treatment or as previous head-amputation (see especially Sivickis, Fig 3) This indicates with a high degree of certainty that the reduction of regenerative potency in all three cases is due to a reduction in the amount of formative material available for regeneration. Studies on the histology of starvation (for example, Schultz, 1904, Stoppenbrink, 1905, Berninger, 1911, Bartsch, 1923) clearly show that such material is used up during starvation, and the work of Steinmann (1925, 1926) shows the close resemblance of the histological changes observed in starvation and in regeneration

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Duration of Life-Cycle of the Death-Watch Beetle

So far as published accounts record, the death-watch beetle (*Xestobium rufovillosum*, De G) has never been bred in the laboratory and no study has, therefore, been possible of the factors affecting its development and the duration of its life-cycle In discussing the treatment of timber roofs attacked by *Xestobium*, Lefroy[1] summarised in 1924 the knowledge of the biology of the insect up to that time and pointed out how little was known of its life-history and habits

During the past four years, a study of the life-cycle and duration of the different stages of the insect has been in progress at the Forest Products Research Laboratory, and in the course of this work the beetle has been reared from egg to adult The results of this investigation—a full account of which will be published elsewhere—lead to the general conclusion that, given a suitable timber, for example, oak or willow, the length of the life-cycle of *Xestobium* depends upon : (*a*) condition of the timber with reference to fungal decay ; (*b*) moisture content of the timber ; (*c*) temperature conditions.

For example, the insect has been reared in the remarkably short period of 11 months in willow in an advanced stage of decay at moisture content of 18–20 per cent (based on dry weight of wood) and at a temperature of 20°–25° C. On the other hand, under similar conditions of temperature and humidity, but with wood in a very much less advanced stage of decay, the beetle has not yet completed its development after a period of 22 months. Furthermore, at temperatures of 20°–25° C., the duration of the life-cycle of the insect reared in oak sapwood, in varying stages of decay, and at moisture contents less than 18 per cent, occupied 28–30 months and longer. Under out-of-door conditions in decayed oak and willow, it has been prolonged still further and has not yet been completed.

Now that it is possible to breed *Xestobium* in the laboratory, further work is in progress on the relationship between the type and extent of fungal decay in timber and its susceptibility to attack. The results so far obtained, however, lend support to the view that the development of *Xestobium* in buildings is extremely slow unless conditions unusually favourable for rapid decay of the timber are present.

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[1] *J. Roy. Soc. Arts*, **72**, (3720), 1924.

Transformations of Isomeric Sugars

DEFINITE evidence is now available of the correctness of the views expressed in our former letter on this subject[1], as, in a smooth series of reactions, we have succeeded in converting *d*-glucose into *d*-galactose and *l*-gulose. The two transformation sugars have been isolated separately and identified.

Starting from α-methylglucoside, an anhydro ring was formed between positions 3 and 4 of the glucose chain as a result of consecutive reactions which gave as the end product an amorphous 2-acetyl 3 : 4-anhydro 6-trityl α-methylhexoside. After opening the anhydro ring, two distinct acetone derivatives were obtained, namely :

(*a*) A monacetyl monacetone methylhexoside, m.p. 101°–102°, $[\alpha]_D$ + 127·3° in chloroform.

(*b*) A monacetyl monacetone methylhexoside, m.p. 176°–178°, $[\alpha]_D$ + 76·8° in chloroform.

On deacetylation, the compound (*a*) gave a theoretical yield of a monacetone methylhexoside, m.p. 109°–110°, $[\alpha]_D$ + 147·2°, from which, on partial hydrolysis, α-methylgalactoside was obtained which showed correct melting point and mixed melting point and a specific rotation of + 175·5° in water. From this, in turn, *d*-galactose was isolated and identified by determination of the optical activity and by conversion into the phenylosazone.

In a parallel series of reactions, the isomeride (*b*) gave a monacetone methylhexoside, m.p. 132°–133°, $[\alpha]_D$ + 88·5° in chloroform. On complete hydrolysis to the parent sugar, the rotation became lævo, $[\alpha]_D$ − 17·9°, and as the phenylosazone melted at 156°, the product was evidently *l*-gulose. The scission of the 3 : 4-anhydro ring in glucose may give four possible products : *d*-glucose, *d*-allose, *d*-galactose and *l*-gulose, and doubtless all are present. Of these only *l*-gulose is lævorotatory, and its isolation together with *d*-galactose is of special interest in view of the relationship of these hexoses with ascorbic acid and lactose respectively. We are accordingly extending our work with the object, *inter alia*, of converting maltose into lactose.

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[1] NATURE, **133**, 871 ; 1934.

Luminous Night Clouds over Norway in 1933 and 1934

As reported in a letter to NATURE[1] large masses of noctilucent clouds were seen over southern Norway in the night of June 30–July 1, 1934. From three of my aurora stations I got a series of simultaneous photographs of these clouds. The plates have now been measured, and the results will soon appear in *Astrophysica norvegica*. The following points from this paper may be of interest.

Seven pairs of plates gave the following 41 heights in kilometres : 82, 83, 82·5, 84, 84, 82·5, 82·5, 82, 83·5, 82, 82, 85, 82·5, 81, 82, 84, 81, 80·5, 81, 82, 81·5, 81, 81·5, 82·5, 82·5, 82, 82, 82·5, 83, 82, 78, 82, 82, 83·5, 82, 82, 81, 83·5, 82·5, 83, 81. The mean, 82·2 km., agrees very well with the mean value 82·08 km. found by Jesse from observations in the years 1889–91. It also agrees with my own measurements from 1932, which gave 81·4 km.

The velocity of the clouds was 80–83 metres a second from east to west. A series of waves with their crests orientated north and south appeared, the distance between successive crests being 6–9 km.

As observed in 1932, sun rays passing nearer to the earth's surface than about 30 km. do not make the clouds shine. This may suggest that the clouds are chiefly illuminated by ultra-violet rays.

From different people I have received observations and photographs of luminous clouds on the following nights : 1933 : July 4–5, 7–8, 9–10, 19–20, and August 9–10, 23–24. 1934 : June 30–July 1, July 5–6, 6–7, 16–17, 17–18, 18–19, 30–31, July 31–August 1, August 7–8.

A very interesting case is the occurrence of such clouds over central Norway on July 19–20, 1933, because similar clouds were observed 33 hours later over Canada[2], coming from the east-north-east, which corresponds to a drift of 48–57 metres a second, if the clouds had drifted from Norway to Canada. For further details I must refer to the complete paper which is in print.

In conformity to the opinion expressed by Vestine in his paper mentioned above, it seems to me that the luminous night clouds are likely to consist of cosmic dust coming from interplanetary space into the upper atmosphere in the same way as shooting stars and meteors. The arguments in favour of this opinion are the following :

(1) The occurrence of luminous night clouds after the great Siberian meteor (1908), also adduced by Vestine as an argument in favour of a cosmic origin of the clouds.

(2) The occurrence of the clouds in the months of June and July, with a maximum near the end of June, which is comparable with the fact that shooting stars appear at certain fixed dates of the year. The reported occurrences of such luminous clouds in the

summer months of southern latitudes, however, seems difficult to explain as the result of the same swarm of cosmic dust

(3) The greatest intensity of the phenomenon after midnight is then intelligible in the same way as the analogous maximum of frequency shown by shooting stars after midnight, due to the fact that the morning side precedes in the earth's motion round the sun

(4) As shown by Vestine, there are more coincidences between luminous night clouds and meteoric showers and comets than between these clouds and volcanic eruptions, which points to a cosmic origin

(5) The blue-white colour points more to fine dust than to water drops and ice-crystals This was also pointed out by Vestine

(6) The sporadic occurrence of the clouds points to irregular precipitations of cosmic dust over limited areas, in particular on the side of the earth which precedes in its motion round the sun

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[1] NATURE, **134**, 219, August 11, 1934

[2] E H Vestine, "Noctilucent Clouds", *J Roy Ast Soc Canada*, July–September, 1934

Musical Atmospherics

THE characteristics of audio musical atmospherics which are obtained when an audio amplifier is placed in a long line or aerial have been discussed from time to time[1] Messrs Burton and Boardman have given an account of their observations in which the musical atmospherics are considered to fall into two categories distinguished mainly by their duration and the frequency gamut covered The short musical atmospherics which occur only at night time, variously christened 'twecks' or 'chinks' lasting 1/20–1/5 sec and covering a gamut of frequency 4,000 to nearly 1,600, can be adequately explained as the multiple reflections between the earth and ionosphere The more interesting long-duration audio atmospherics, variously called 'swishes', 'whistlers', *Pfeifone*, have received no adequate explanation although many suggestions have been offered I have maintained for some time that the effect is due to the dispersion of a pulse in the ionosphere, and a theory has been developed which accounts for the main characteristics of such audio atmospherics.

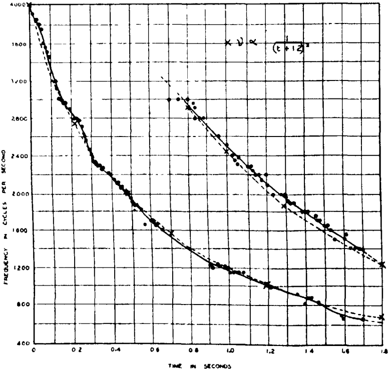

FIG 1 Frequency curve of a 'swish pair'

In this theory, a pulse originating in the lower atmosphere as a lightning flash, or more probably produced in the upper atmosphere by a burst of ions from the sun, produces a spectrum of electromagnetic waves which traverse the spherical channel formed by the ionosphere and are reflected at the polar regions

The theory supposes that it is possible that waves of such low frequency (between 400 c /sec and 4,000 c /sec) can traverse the densely ionised region of the ionosphere There are two alternative theories of the dispersion in an ionised region according as the Lorentz-Hartree correction is included or not, in which the refractive index is either

$$1 - \frac{\zeta}{1 + \frac{1}{3}\zeta} \text{ or } 1 - \zeta, \text{ where } \zeta = \frac{Ne^2c^2}{\pi m\nu^2}$$

(No magnetic field)

If the former is correct, then for frequencies less than the critical frequency ν_e (over dense medium), $\nu_e{}^2 = Ne^2c^2/\pi m$, the ionosphere is completely lacking in transparency for either ordinary or extraordinary ray whatever the direction and magnitude of the earth's magnetic field If the latter is correct, then the ionosphere is transparent to the extraordinary ray if $\nu < \nu_1 = eH/2\pi m$ and if the direction of the ray is not too nearly perpendicular to the earth's magnetic field Clearly the theory proposed is only possible if the Lorentz-Hartree correction is neglected A consequence of the theory is that the frequency of the whistler at any time t after the initial pulse should be proportional to $1/t^2$ so long as all the waves traverse approximately the same path irrespective of frequency

Messrs Burton and Boardman have obtained a record shown in Fig. 1 of the frequency of a whistler as a function of the time The dotted curve shows the relation $\nu \alpha 1/(t + 1\ 2)^2$, where t is the time elapsed from the observed start of the whistler. The 1 2 sec. should then represent the time between the initial pulse and the start of the musical disturbance. (The initial impulse was not audible in this case but intervals of this order are often observed.) The agreement between the theoretical and observed form is quite close

The results may perhaps be considered as evidence (1) that the whistler is caused by the dispersion of a sudden pulse travelling through the ionosphere

(2) that the simple form of dispersion formula (without the Lorentz-Hartree correction) is correct for transmission in an unpolarised medium like the ionosphere.

This is the conclusion arrived at by Darwin[2] on theoretical grounds.

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[1] Barkhausen, *Phys Z* , **20**, 401–403 , 1919 *Proc I R E* , **18**, No 7, July 1930 Shellang, *Bell Tel J* , Aug 1930 Eckersley, *Phil Mag* , **49**, 1250 , 1925 NATURE, **122**, 768 , 1928 Burton, NATURE, **126**, 55 , 1930 Barton and Boardman, *Bell Tel J* , **12**, 498–516 , 1933

[2] Darwin, NATURE, **133**, 62 , 1934

Over-Potential of the Hydrogen Isotopes

ALTHOUGH the separation of the two hydrogen isotopes which occurs on electrolysis must be closely connected with their over-potentials, no measurement of these has been published A comparison of the deuterium over-potential with that of hydrogen can be of value in elucidating the general mechanism of hydrogen over-potential itself and, as part of an experimental investigation of this, measurements have been made on deuterium. In order to eliminate errors due to the resistance of the electrolyte and to violent gas evolution, it is essential that very low current densities should be used, and the electrolyte must be free from traces of oxygen or dissolved impurities The over-potential measurements were made under conditions similar to those described in earlier papers[1], but it was a matter of some experimental difficulty to realise these with the small quantities of electrolyte available (1 c c). The results obtained with a mercury cathode in a 0 2 *N* sulphuric acid electrolyte are shown in Fig. 1

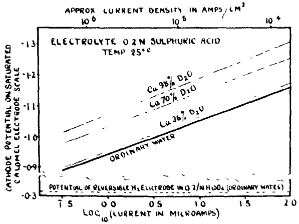

FIG 1

It is apparent that both isotopes give the same linear relation between current density and over-potential, and that the slope of the line is nearly the same in each case[2] ($\alpha = -2\ 3\ RT\ d\log i/dV =$ about 0 5). The irreversible potential of the deuterium is, however, considerably higher than that of hydrogen (*c.* 0 13 volts more negative) For 100 per cent heavy water the difference would be slightly greater. (The over-potential is, strictly, the potential difference between an irreversible electrode and a reversible electrode working in the same electrolyte. Measurements made in this laboratory by Dr. K. E. Grew show, however, that the potential difference between a reversible deuterium electrode and a reversible hydrogen electrode is small)

From these measurements it is clear that the over-potential difference between the isotopes is sufficiently great to explain the separation which occurs on electrolysis From the curves we may calculate a possible separation factor under these optimum conditions For example, at a cathode potential of − 1 05 volts sat cal

$$\frac{\text{the rate of evolution of } H_2}{\text{the rate of evolution of } D_2} = \frac{9\ 23 \times 10^{-6}\ \text{amp}}{0\ 668 \times 10^{-6}\ \text{amp}} = \frac{13\ 8}{1}.$$

We have also measured the temperature coefficient of the deuterium over-potential and find that it is greater than for hydrogen, showing that the efficiency of separation will decrease as the temperature increases

As would be expected, the actual separation factor observed during the preparation of heavy water is considerably less than the possible one suggested above. (It varies from *c.* 3 at a reversible electrode to *c* 8[3,4]) Under the usual conditions of electrolysis, there are many factors such as high current density, high local temperature, concentration polarisation, low over-potential properties of the electrode surface, interchange, etc , all of which tend to lower the efficiency. The bearing of these results on the mechanism of over-potential will be discussed elsewhere

It is with much pleasure that we express our thanks to Drs A and L Farkas for analysing the heavy water and to Imperial Chemical Industries, Ltd , for a grant

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[1] Bowden, *Proc Roy Soc* , A, **125**, 446 , 1929

[2] Bowden, *Proc Roy Soc* , A, **126**, 108 , 1929

[3] Farkas and Farkas, *Proc Roy Soc* , A, **146**, 623 , 1934

[4] Eyring and Topley, *J Chem Phys* , **2**, 217 , 1934 Bell and Wolfenden, NATURE, **133**, 25 , 1934

Fundamental Dimensions of μ_0 and K_0 in Electrical Science

THE recent work of committees both national and international upon the fundamental units and definitions in electrical science has shown that a considerable further step in advance, by removing difficulties, would result from the discovery of the dimensions of μ_0 and K_0, the magnetic permeability and electric permittivity or specific inductive capacity of the medium Some writers have recommended that the dimensions of one of these should be chosen arbitrarily in order to get this simplification, the result of which would be that the difference in physical dimensions of the various quantities, when measured in electrostatic and electromagnetic units, would disappear. Difference in size of unit causes no confusion, but the difference in dimensions due to changing the scale of measurement has been a great cause of confusion.

Electrical science is based fundamentally upon the definitions of quantity of electricity e, magnetic pole m and electric current i. The definitions of these three quantities are given by the three equations :

$$\text{force} = ee'/K_0r^2 \ . \ . \ (1) \quad \text{force} = mm'/\mu_0r^2 \ . \quad (2)$$
$$\text{and } i = de/dt \ . \ . \ (3).$$

In these equations, μ_0 and K_0 are dimensional constants the numerical value of which would depend upon the units of measurement, but their physical dimensions depend solely upon the medium In the historical development, i is, again, defined electrodynamically either by the action of a current upon a magnetic pole or upon another current, and the two systems of units are thus introduced with their different dimensions for each quantity

I am only concerned with the physical dimensions and not with the sizes of the units Let us assume that the symbols used contain their own units, just as is common practice in dynamics We have already defined i, and therefore there is no necessity to introduce another definition for it.

Ampère's fundamental equation in electrodynamics is given by

$$\text{force} = ii'\,ds\,ds'\,(1{\cdot}5\cos\theta\cos\theta' - \cos\epsilon)/A'r^2 \qquad (4),$$

representing the force between the elements ds, ds', distance r apart, carrying currents i, i'; θ, θ' and ϵ being respectively the angles between the elements and r and between the elements themselves, and A' is a dimensional constant Having already defined i, let us take this as an empirical equation

Maxwell states as a fact that an electric circuit is *equivalent* to a magnetic shell bounded by the circuit, a discovery which he ascribes to Ampère The physical meaning of this equivalence is explained by modern electronic theory, which ascribes all magnetic phenomena to the electronic orbits in the atoms, thus reviving a suggestion of Ampère's in 1820 that all magnetic phenomena might be due to electric currents round the particles of matter The molecular magnets of Ewing's useful theory are also thus accounted for.

The interpretation to be attached to the meaning of the word *equivalent* has a most important effect upon the science The interpretation adopted by standard practice is contained in the equation $mL = \mu_0 iL^2$, corresponding to the magnetic flux being μ_0 times the magneto motive force, or the current circuit and the magnetic shell are considered as cause and effect connected by the modulus μ_0 This interpretation leads to the present system having dual dimensions for each quantity, connected by $c^2\mu_0 K_0 = 1$

I submit that, in the light of electronic theory, another interpretation of the phenomena and of the meaning of the word equivalent, is that the magnetic flux is part and parcel of the current and is only another partial aspect of the phenomena , and, just as in vortex motion we speak either of the vortex or its core, so in electromagnetism we may speak either of the magnetic flux or of its core i The result of such an interpretation is that each ampere turn of magneto motive force produces its quantum of flux just like the equivalent magnetic shell given by $mL \equiv iL^2$, and that all magnetic phenomena without exception may be regarded as the vector sum of all the magnetic shells due to all externally applied magneto motive forces, together with those due to internal magneto-motive forces arising from the polarisation of the electronic orbits in iron or other magnetic material.

The consequence of this interpretation is that the only permeability is that of vacuum, and it has no dimensions because of the equivalence In dealing with circuits containing iron, however, it is immaterial whether the increased flux be ascribed numerically to increased magneto-motive forces or to increased permeability, hence the variable μ may be retained but always as a numeric.

We can deduce from the fact that $\mu_0 = 1$, that $c^2 = 1/K_0$ and also that the electrostatic system of dimensions disappears, but let us develop this result more slowly

A consequence of all magnetic phenomena being electromagnetic is that equation (2) becomes a particular integral of equation (4), whence $mm'/\mu_0 = ii'L^2/A'$, and if $m \equiv iL$, $A' = \mu_0 = 1$ From equations (1) to (4), $e^2/K_0 = m^2/\mu_0 = e^2V^2/A'$, and if $A' = \mu_0 = 1$, then $e^2/m^2 = K_0 = 1/V^2$ The velocity of electromagnetic waves derived from equations (1) to (4) is given by $c^2 = A'/\mu_0 K_0 = 1/K_0$ which agrees with Maxwell's electromagnetic system, since μ_0 is a numeric in that system

The result of the simple assumption that all magnetic phenomena are in fact electromagnetic and that Faraday's equivalence between an electric circuit and a magnetic shell is a real equivalence, in the sense of being synonymous, or different aspects of the same phenomena, is that electrical science is reduced to a singular system of dimensional quantities agreeing with Maxwell's electromagnetic system, and the electrostatic system disappears The numerical values of the units of course remain unaltered

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Humidity in Relation to Sheep Blowfly Attack

IN a recent letter to NATURE[1], Holdaway and Mulhearn conclude that (in Australia) "there is a relation between sweat content and susceptibility to weather stain and body strike" by blowflies It is not clear whether they regard the predisposing factor to be the accumulation of sweat constituents (suint) in the wool (from the reference to yolk colour such would be presumed) or the excessive moisture produced by sweating

In studies on the blowfly problem in Great Britain, it seemed desirable at the outset to investigate the rôle of humidity in relation to sheep maggot attack. *In vitro* experiments showed that eggs and first instar larvæ of *Lucilia sericata*, Meig , are highly susceptible to dry conditions and would not be able to survive on the sheep's skin unless the humidity exceeds 90 per cent for several hours The humidity of the fleece, therefore, is a vital factor in sheep maggot attack. A technique was devised for measuring the humidity of the microclimate at the base of the wool and observations were made under various meteorological conditions on Welsh sheep, a breed susceptible to blowfly attack It was found that the humidity at the wool base was surprisingly low over the back, ranging from 38 to 78 per cent but seldom exceeding 70 per cent even in showery conditions However, in the region of the breech, the humidity was often high owing to the soiling of the wool with fæces or urine ; this is the site of the majority of attacks in this country. It can be concluded that normally the humidity at the base of the wool is too low for the development of larvæ of *Lucilia sericata*. This was confirmed by placing eggs and young larvæ on sheep, when myiasis did not result unless the wool was kept wet by frequent watering. Also, we have on several occasions found desiccated eggs and larvæ on sheep in the field.

In Australia among Merinos, body strike is associated with an infectious condition of the wool producing "weather stain" and it is prevalent following "excessive rains and humid conditions generally" Attacks on the back are not uncommon in this country, in fact, they were especially prevalent in North Wales during the *dry* summers of 1933 and 1934, infestation usually beginning in the region between the shoulder-blades Clearly, the humidity at this spot must sometimes become abnormally high, perhaps owing to excessive sweating The humidity at the wool base was occasionally found to be higher in this region than elsewhere on the back

We have, therefore, concluded that in Great Britain, whether fæces, urine or sweat be responsible, it is the moisture in each instance which permits the establishment of sheep maggots

These results will shortly be published in detail elsewhere

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[1] NATURE, 134, 813, Nov 24, 1934

Mutations and the Ageing of Seeds

M NAVASHIN[1] and his co-workers reported in a series of papers that plants produced from old seeds in *Crepis* show a great percentage of 'mutations' Similar observations were reported by Cartledge and Blakeslee[2] and by Peto[3] in America working with various plants They confirmed the results found by Navashin and his co-workers All these authors state that Navashin made this discovery. Hugo de Vries, however, in his "Mutationstheorie" (1901)[4], reported that in one case five-year old seeds from *Oenothera* gave 40 per cent instead of 5 per cent mutations (p 185) He interpreted this phenomenon by postulating a longer viability of the 'mutated' seeds (p 186)

More extensive studies on the ageing of the seeds in *Oenothera* were reported by Nils Heribert Nilsson (1931)[5] He summarised his observations in a table and from the results obtained he drew the following conclusion "Mit dem Alter des Samens, also mit der herabgesetzten Keimfähigkeit, geht das Ansteigen des Mutationsprozent ausgesprochen parallel" (p 326).

Recent investigations (see, Cleland, Darlington, Gates, Renner, Oehlkers, and others) showed that some of the mutations in *Oenothera* are due to segmental interchanges between non-homologous parts of the chromosomes Consequently the mutations reported by H. de Vries and N. Heribert Nilsson are obviously due to chromosomal alterations Chromosomal alterations (but not gene mutations) were reported by Navashin too, that is, Navashin confirmed cytologically the observations reported by de Vries and Heribert Nilsson

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[1] Navashin, NATURE, 131, 436, 132, 482, 1933. *Planta* 20, 238, 1933.
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[3] Peto, *Canad J Res*, 9, 261, 1933
[4] H. de Vries, "Mutationstheorie", 1901, pp 185, 186
[5] Nils Heribert Nilsson, *Hereditas*, 15, 320, 326, 1931

Vitamin B_1 and Blue Fluorescent Compounds

FLUORESCENCE in ultra-violet light (screened by Wood's glass) is not a property of vitamin B_1; but I have found that the purest preparations in our possession (method of Kinnersley, O'Brien and Peters, 1933[1]) can be converted by oxidation in aqueous solution into substances showing an intense sky-blue fluorescence

Blue fluorescent compounds are stated to arise as breakdown products of the yellow fluorescent flavins (Kuhn, *et al*[2]), hence the Bence Jones 'quinoidine' substances in yeast extracts (Kinnersley, Peters and Squires[3]) can originate from vitamin B_1 as well as from vitamin B_2 Arising from my observation upon vitamin B_1, it seems to be possible for the first time to postulate a relation between vitamin B_1 and the pyrimidazine group In this connexion it is interesting to note that the empirical composition $C_{12}H_{18}ON_4S$ of vitamin B_1 (Windaus *et al*[4], Holiday *et al*[5]) corresponds with that of a thio-hexahydro lumichrome (lumichrome $C_{12}H_{10}O_2N_4$) The hydrogenation of the azine or benzene rings may account for the strength of the vitamin as a base and for its high water solubility

The several lines of investigation thus indicated are being actively pursued by ourselves and colleagues, though it is admittedly difficult to reconcile our working hypothesis with the formation of the particular degradation products of vitamin B_1 recently described by Windaus, Tschesche and Grewe[6] So far, it has not been found possible to replace vitamin B_1 with flavin in the specific respiration of avitaminous brain tissue, which is catalysed by vitamin B_1[7]

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[1] *Biochem J*, 27, 232 1933
[2] Kuhn, Rudy and Wagner-Jauregg, *Ber deut chem Ges*, 66, 1950, 1933 See also Stern and Holiday, *Ber*, 67, 1442 and Karrer Salomon, Schopf, Schlittler and Fritzch, *Helvet Chem Acta*, 17, 1010, 1934
[3] *Biochem J*, 19, 404, 1925 See also von Euler and Adler, *Z physiol Chem*, 223, 1, 1934
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Testing for Unconsciousness After an Electric Shock

IT has been definitely proved that the tests of consciousness used in chloroform anæsthesia cannot safely be assumed to be valid in the case of an animal or person who has been immobilised as a result of an electric stimulation of the brain The matter is of great importance because, as a result of the Slaughter of Animals Act, electric immobilisation is being extensively used in the slaughter-house as an alleged anæsthetic, and its use for operations, both veterinary and experimental, has been proposed

The object of this letter is to point out that there exists a strong tendency to stifle inquiry into this unsettled question, and to discourage further investigation by making statements which imply that electrolethalling has been proved to cause genuine anæsthesia It is not difficult to explain this tendency to brush aside unsettled questions, for there are strong motives for desiring to believe that electrolethalling, as practised in the slaughter-house, is humane Moreover, vested interests have grown up around the practice, and humanitarians who have prematurely endorsed it are reluctant to believe that their judgment may have been wrong

Many wild theories have been put forward with the object of explaining the observed phenomena in accordance with the wishes of those who propound them, and objective data on the subject are extremely restricted in their scope The following facts appear, however, to be established —

(1) It is possible to produce, by passing a suitable electric current through the brain, a nightmare state in which the subject retains his senses, but appears to an external observer to be completely unconscious, the pupil reflex being absent The conditions under which this state can be produced have not been satisfactorily delimited, but they appear to approach those employed in the slaughter-house The requisite range of conditions, whatever it may be, is one which sometimes although very rarely occurs in electrical accidents

(2) A weak interrupted direct current produces the same objective phenomena as sinusoidal (electrolethaller) current twenty times stronger as read with an ammeter. Thus it is found that to get the desired objective effects on pigs in the slaughter-house the sinusoidal electrolethaller current *must lie roughly* between half an ampere and one ampere, while Regensburger gets similar results with 10-per-cent-interrupted direct current of from 31 to 53 milliamperes

(3) Controlled experiments on human beings have not been carried quite up to the point where the subject fails to recover his mobility immediately on the cessation of the current In slaughter-house practice the current strength lies just above this point, and it must have done so in the case of those rare electrical accidents in which the nightmare state persisted after the accident.

(4) Leduc submitted himself to interrupted direct current up to 4 milliamperes but failed to reach unconsciousness, although his assistants supposed him to be completely unconscious for twenty minutes He felt sure, however, that if the current had been raised a very little higher unconsciousness would have ensued Dr J Hertz, in Paris, therefore repeated the experiment on incurable invalids with currents up to 25 milliamperes (or 18 milliamperes where the on period was 10 per cent) but Leduc's prediction was not fulfilled The subjects failed to pass beyond the nightmare state They exhibited permanent dilation of pupils and were unable to respond to stimuli, but they retained their sensibility.

(5) Breathing was sometimes inhibited during the nightmare state in Hertz's subjects, and in some victims of electrical accidents. Zimmern in particular refers to an accident in which the victim knew that he could not breathe voluntarily and dreaded that artificial respiration might be abandoned prematurely

(6) The muscles in Hertz's subjects were sometimes contracted and sometimes relaxed The absence of squealing in electrolethalled pigs is *not therefore necessarily due either to muscular* contraction or to unconsciousness It may, for all we know, be due simply to the nightmare state.

(7) Whether the pigs, if conscious, suffer pain from the current must depend on whether their muscles are relaxed or violently contracted Both conditions may occur in practice.

I intend to publish before long a more detailed statement of the above points, the purpose of the present letter is to urge that every effort should be made to encourage inquiry into an unsettled question, with regard to which we require new data based on research and not dogmatic assertions based on the will to believe.

C W. Hume.

14, The Hawthorns,
Finchley, N 3
Dec 1

Magnetism of Tin

S Ramachandra Rao has reported[1] that, on testing colloidal powders of white tin magnetically, its paramagnetic susceptibility becomes diamagnetic as the particle size decreases, this diamagnetism increasing as the particle size decreases. A few years ago we often observed the same phenomenon in the investigation of the effect of cold-working on the susceptibility of white tin. In our case we found that the paramagnetic susceptibility of white tin changes its sign as the internal stress caused by cold-working increases, this value of diamagnetism increasing in proportion to internal stress This change of susceptibility has been explained by a slight expansion of tin by cold-working[2].

Thus the interesting phenomenon observed by *S R Rao may be explained as follows* As a theoretical calculation shows, the lattice constant of a metal is somewhat larger in the surface layer than in the interior, the constant attaining gradually its normal value at some hundred layers below the surface Hence it is to be expected that, as the particle size of tin diminishes, its mean lattice constant increases; the result of colloidalisation is therefore the same as that of cold-working Hence we may assume that through the volume expansion due to colloidalisation of tin, its magnetic susceptibility is affected in two different ways:

(1) The decrease of paramagnetic susceptibility due to the diminution of free electrons caused by the expansion.

(2) The increase of diamagnetic susceptibility due to the increase of bound electrons caused by the expansion

In the case of cold-working of white tin, its susceptibility is observed to change, for example, from $0\ 027 \times 10^{-6}$ to $-\ 0{\cdot}0049 \times 10^{-6}$, corresponding to a change of density by cold-working from 7·291 to 7 280 The calculated value of the susceptibility corresponding to this change of density is from $0{\cdot}0270 \times 10^{-6}$ to $-\ 0{\cdot}0051 \times 10^{-6}$; the agreement between the observed and theoretical values is satisfactory. It may, therefore, be concluded that the curious change of susceptibility from a positive to a negative value in the case of colloidalisation is due to the increase of the mean lattice constant due to refining of tin particles; but a quantitative comparison between the theoretical and observed values cannot be made, as the change of density caused by colloidalisation has not yet been measured.

Kotarô Honda
Yosomatsu Shimizu.

Research Institute for Iron,
Steel and Other Metals,
Sendai, Japan.
Dec. 15.

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[1] Nature, 134, 288, Aug 25, 1934

[2] K Honda and Y Shimizu, Nature, 132, 565, 1933. Y. Shimizu, *Sci Rep.*, 22, 915, 1933

Magnetic Induction in a Supra-Conducting Lead Crystal

IN our last note[1] we showed the relation between magnetic induction and field strength in the case of a polycrystalline lead rod. We now report shortly on analogous experiments carried out with a lead single crystal

The measurements were carried out at various temperatures with the second method that we described, the magnetic moment of the supra-conductor being determined in a constant field One may conclude from Fig 1, in which the results of our measurements at 4 24° K. are shown (full curve), that the destruction of supra-conductivity occurs in almost the same way in single crystals and in polycrystalline lead. The sudden rise of the induction begins almost exactly at the same critical field strength H_k as in polycrystalline material, however, in single crystals the transition region, that is, the field interval in which the transition from one state to the other begins and terminates, is considerably narrower, extending over merely 7 gauss In the transition region, the induction is observed to rise slightly with time in a constant magnetic field

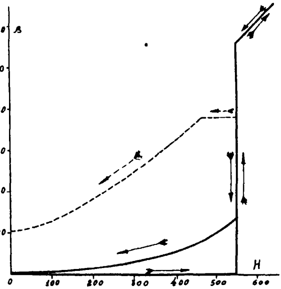

FIG. 1.

However, the reverse process, the appearance of supra-conductivity on moving from strong fields to fields less than H_k, is found to be different for single crystals and polycrystalline rods For comparison, the dotted curve on the same figure shows the relation between B and H for polycrystalline lead It appeared that in this transition the induction followed a change in the field strength slowly, the process depending strongly on time The dependence on time was particularly strong in the transition region of the field strength—the same field strengths as those at which the supra-conductivity was destroyed—where even after waiting for half an hour we did not succeed in reaching a state of equilibrium, the induction still changing with noticeable velocity. As the period of our experiments was limited by the speed with which the helium evaporated, the curves which we obtained in decreasing magnetic fields do not correspond to the equilibrium state On decreasing the field strength to zero a residual magnetisation is observed, which in different experiments varied between 0 and 2 per cent of the maximum of B in the transition region. It was found that the residual magnetisation sank noticeably with time

The strong dependence on time and the small hysteresis in single crystals have convinced us that all states of a supra-conductor with an induction differing from zero are unstable These experiments again confirm the concept of two phases, an ordinary and a supra-conducting phase with an induction equal to zero. The transition from the supra-conducting to the ordinary phase occurs rapidly, whereas the reverse transition takes place more slowly It is interesting to note that the latter process occurs so gradually that a fairly sensitive telephone in connexion with an amplifier is insufficient to detect any spontaneous changes in the induction

G N RJABININ
L W SHUBNIKOW

Ukrainian Physico-technical Institute,
Kharkov
Nov. 25

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[1] G N Rjabinin and L W Shubnikow, NATURE, 134, 286, Aug 25, 1934

Symbols for Chromosome Numbers

WHILE in entire agreement with Prof Gates's view[1] that a convention should be agreed upon to distinguish between the basic and the haploid chromosome number, I am not convinced that the introduction of a new symbol is necessary. The use of x to indicate the basic number, leaving n for the haploid number, has been the standard practice in this laboratory for the last three years[2] In spite of Prof Gates's fears, no confusion seems to arise from its use. I may also point out that a Greek letter has the grave practical disadvantage of being troublesome to print and impossible to type on an ordinary machine

BRENHILDA SCHAFER,
Librarian.

John Innes Horticultural Institution,
Merton Park, London, S W 19
Jan 1

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[1] NATURE, 134, 1011, Dec 29, 1934

[2] See Darlington, 'Recent Advances in Cytology , p 61 (1932), Sansome and Philip, "Recent Advances in Plant Genetics", p 165 (1932), Crane and Lawrence, "The Genetics of Garden Plants", p 28 (1934)

Publication of *Nomina Nuda*

WE wish to support the appeal of Sir Sidney Harmer in NATURE of December 22 (p 973) for the suppression of *nomina nuda* by editors of scientific publications

Editors, however, cannot always be expected to recognise the character of names which, like the one that has caused Sir Sidney Harmer's protest, may perhaps be called *nomina seminuda* We would further appeal, therefore, to writers of zoological papers to avoid using names that are not formally introduced according to the rules of zoological nomenclature

C. TATE REGAN,
Director.
W. T. CALMAN,
Keeper of Zoology.
N. D. RILEY,
Keeper of Entomology
W. D. LANG,
Keeper of Geology

British Museum (Natural History),
London, S.W 7
Jan 7

Points from Foregoing Letters

X RAY investigation of thin films of myosin, the protein substance of the muscle, by Mr W T Astbury and Mrs Sylvia Dickinson, shows that this substance, when stretched, behaves very much like α keratin, which is derived from hair. Keratin differs from myosin mainly in containing the sulphur compound, cystine the authors raise the question whether hair might not be considered as 'vulcanised' muscle

Prof G Hevesy points out that, while the isotopes of potassium of atomic weight 40 or 41 may be responsible for its radioactivity, there still remains the difficulty of reconciling the computed long life of these isotopes with the half-million volt energy of the electrons emitted by potassium. Prof F H Newman and Mr H J Walke suggest that the radioactivity of potassium may be due to extremely small amounts of an isotope of weight 40 hitherto undetected, which may have arisen from the action of neutrons upon the abundant calcium isotope of the same atomic weight

Copper and lead though of greatly different atomic number (29 and 82) are found by Dr Giulia Alocco to absorb the more penetrating cosmic particles to the same extent The softer cosmic shower producing 'radiation' is unequally absorbed by substances of different atomic number

Certain irregular variations with time in the amounts of cosmic rays are found by Prof V F Hess and Dr. W Illing to be due mainly to the softer components and to be related to variations, in the opposite sense, in the horizontal component of the earth's magnetic field

Dr Leo Szilard and Mr T A Chalmers report that the heavy element indium, when bombarded with neutrons, yields radioactive substances of three different life periods Since indium has only two known isotopes (113 and 115), one of them must be activated with two periods This had been observed previously only with light elements.

The radioactivation of iodine by means of neutrons liberated from heavy water by the gamma rays of radium is reported by Dr T E Banks, Mr T A Chalmers and Prof F L Hopwood This raises interesting questions concerning atomic transmutations that might be brought about within the living body

The ordinary hydrogen molecule (H_2) is the simplest known molecule, and the first task of any physical theory that aims at explaining the nature of matter is to account for its structure, as indicated by its spectrum Prof O W Richardson reports several new systems of bands in the H_2 spectrum, and discusses the electronic configuration that might account for them

Europium bichloride gives in ultra-violet light a brilliant purplish-pink fluorescence, the spectrum of which contains a broad band in the blue, identical with that given by fluorite under the same condition This is considered by Dr K. Przibram as additional evidence that the blue fluorescence of fluorspar in ultra-violet light is due to the presence in that mineral of the rare element europium, in the form of a bivalent salt

In the spectrum of the light scattered by liquids (Raman effect) two 'wings' of continuous light usually appear at the sides of the primary line. Dr E Gross and Mr M Vuks bring evidence from the light scattering behaviour of diphenyl ether to show that these 'wings' are not due to the rotation of the molecules, as usually assumed, but to the vibrational Raman effect

Synthetically produced auxin, the hormone responsible for growth by the elongation of the cells, is found by Dr K V Thimann and Mr. J B. Koepfli to be also fully active in promoting root-formation on pea cuttings From this they deduce that the growth promoting and root-forming substances of plants are identical

From the rate at which eyes are regenerated in decapitated (well fed but previously starved) flatworms (*Dendrocoelum*), Dr A A Wolsky deduces that starvation reduces the amount of formative material available for regeneration

Cosmic dust coming from inter-planetary space is probably responsible for the luminous night clouds observed in Norway and Canada Prof Carl Störmer gives particulars of their height (82 km) and velocity, as determined in Norway during 1933 and 1934, he suggests that the clouds are chiefly illuminated by ultra-violet rays

The 'swishes' or 'whistlers' sometimes heard in radio receivers are produced, according to Mr T L Eckersley, by the dispersion of a sudden pulse travelling through the electrically-conducting layer of the upper atmosphere (ionosphere) and reflected at the polar regions Mr Eckersley brings evidence to prove that the observed change in frequency with time in the case of a 'swish pair' agrees with that to be expected from his theory

The usual method of separation of heavy from ordinary water depends upon the fact that, during electrolysis, ordinary water is decomposed first, leaving the heavy component behind Dr F P Bowden and Mr H F Kenyon have measured the over-potential of heavy hydrogen as compared with the ordinary variety and from its value calculate that, under optimum conditions of electrolysis, about fourteen times more H_2 than D_2 is liberated at the cathode

Sir James Henderson proposes to simplify the dimensions of electrical and magnetic quantities, basing his suggestions on the view that all magnetic phenomena are due to electronic motion He postulates that the only permeability is that of vacuum and that it has no dimensions This makes $\mu_0 = 1$ and $K_0 = 1/c^2$, so that the electrostatic system of dimensions disappears'

A sky-blue fluorescence in ultra-violet light is developed, upon oxidation, in the anti-beriberi vitamin (B_1). Prof. R. A Peters reports this change and indicates its bearings on the, as yet undetermined, chemical constitution of vitamin B_1

The change in the magnetic susceptibility of white tin from para- to diamagnetic when it is reduced to a colloidal powder, as observed by Dr S. R. Rao, is analagous to the same magnetic change produced by cold working, according to Prof K. Honda and Dr. Y Shimizu. These authors explain both phenomena as due to the different atomic arrangement in the surface layers from that in the interior, the lattice constant being larger in the surface layer

Sir John Flett, director of H M Geological Survey, for his researches "concerning the mineral structure of the Earth" in the realms of petrological, palæontological and stratigraphical geology , Murchison Medal to Prof E B. Bailey, professor of geology in the University of Glasgow, for his researches in stratigraphical and tectonic geology ; Lyell Medal to Prof D M S. Watson, Jodrell professor of zoology and comparative anatomy in University College, London, in recognition that he has "deserved well of the Science" in the fields of palæontological and stratigraphical geology , Bigsby Medal to Prof H H Read, George Herdman professor of geology in the University of Liverpool, "as an acknowledgement of eminent services" to petrological, structural and stratigraphical geology The balance of the Wollaston Fund has been awarded to Dr. W J Arkell, of the Murchison Fund to Mr J V Harrison, and of the Lyell Fund to Mr J J Hartley and Mr L R Wager

Edison Medal Award

THE Edison Medal for 1934 has been awarded by the American Institute of Electrical Engineers to Prof Willis R Whitney, "for his contributions to electrical science, his pioneer inventions, and his inspiring leadership in research" The Edison Medal was founded by associates and friends of Thomas A Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by the American Institute of Electrical Engineers Prof Whitney has been vice-president in general charge of research of the General Electric Company, Schenectady, New York, since 1932

Equivalence of Energy and Inertial Mass

ON December 28, during the meeting at Pittsburgh of the American Association for the Advancement of Science, Prof. A. Einstein delivered the Josiah Willard Gibbs Lecture of the American Mathematical Society. The accompanying summary was provided by Prof Einstein for the use of Science Service · "It is well known that the equivalence between energy and inertial mass is one of the most important consequences of the special theory of relativity, this principle forms at present a useful tool of research in the physics of atomic nuclei. The theoretical derivation of this principle of equivalence, while restricting myself to what is conceptually necessary, is the subject of my lecture. From the Lorentz transformation and the assumption of the impulse and energy principle for material particles, the form of the impulse and energy of the moving particles, as well as the equality of mass and rest-energy, is derived. The whole proof is based on the consideration of an elastic and an inelastic collision between two identically constituted material particles."

Limits of Industrial Employment

DR. E. C SNOW, in a paper read before the Royal Statistical Society on January 15, discussed "The Limits of Industrial Employment—the Influence of Growth of Population on the Development of Industry". The first part of the paper dealt in considerable detail with the facts of growth of population in the nineteenth century and up to the outbreak of War During a considerable part of that period, the population of England and Wales was increasing at the rate of 300,000–350,000 per annum—entirely due to the decline in the death rate This decline in mortality was not peculiar to industrialised Great Britain, but was equally marked in other agricultural countries The analysis of the statistical evidence seems to justify the view that the growth of industry in Great Britain was not the direct cause of the increase in population The population circumstances of England and Wales at the present time are widely different from those ruling up to the time of the War The population at ages under thirty-five years is declining At ages over sixty it is still increasing, but the net effect is an annual increase of population of not more than a quarter of that before the War The economic effect of the smaller rate of population growth now is indicated by the fact that the quantity of foodstuffs imported since 1924 has increased at less than 1 per cent per annum The overseas countries which rely on this market for an outlet for a large part of their production of foodstuffs are living in the expectation that Great Britain can increase its imports of food at the old rate of 5 per cent per annum, whereas, in fact, it has for some time only been increasing at the rate of 1 per cent per annum, and before long even this small rate of increase is likely to decline

Russian Academy of Sciences

THE recent decision of the Soviet Government to transfer the Russian Academy of Sciences and its affiliated institutions from Leningrad to Moscow marks the beginning of a new period in the history of the Academy, which dates back more than two hundred years As is pointed out in the *Izvestia*, the transference is not a measure dictated merely by consideration of convenience Indeed, the accommodation which has to be provided at short notice for more than a hundred institutes, laboratories, museums, etc , forming the Academy is only obtainable in the already overcrowded Moscow mainly at the expense of other institutions, which are being moved elsewhere New and spacious buildings are being erected at a 'shock speed', but mostly just planned, while many of the institutions are actually moving. In addition, living quarters have to be provided for the thousands of academic officials and their families, since all flats, rooms, etc in Moscow are under the strictest State control. All these difficulties have resulted from the recent decree by which the Academy has been brought under the direct control of the Soviet of the People's Commissars New statutes for the Academy are being prepared in order to replace "the old traditions of purely academic outlook" by work on problems connected with the "socialistic reconstruction" of the country. While the new order will possibly mean increased material support for some of the academic institutions, the decision as to whether or not a certain branch of abstract research deserves support will apparently be now in the hands of laymen officials.

Association of British Zoologists

THE annual meeting of the Association of British Zoologists was held on January 5, in the rooms of the Zoological Society in Regent's Park, under the presidency of Prof. F. Balfour Browne. The morning session was given to a discussion of the general trends of zoological science at the present time. In opening the discussion, Prof. D. M. S. Watson defined zoology as the science of animal life in all its aspects. He emphasised the recent tendency of zoology to return from the strictly taxonomic and morphological outlook of the latter part of the last century to the more biological outlook of pre-Darwinian zoologists. He concluded that the reason for this tendency, in spite of the undeniable importance of a knowledge of comparative morphology for all branches of zoology, is that the time is now past when important alterations in our conceptions of morphology are likely to occur. He thinks that the greatest need to-day is a wider knowledge of the animal as a living thing, and of those branches of zoology, such as comparative physiology, embryology and genetics, on which knowledge of animal life must rest. In recent years this need has been brought even more clearly to the front by the great extension of the economic applications of zoology.

IN the discussion which followed, there was almost complete agreement with Prof. Watson both in his definition of zoology, and in the emphasis which he laid on the development of zoology as the study of the living animal. Dr. J. Gray dwelt on the need for teachers to treat the animal as a living thing. In the past, and still to a large extent to-day, zoological teaching has, he thinks, failed to give a broad picture of animal life; to repair this failure is its most pressing need. In comparative physiology, which provides a large proportion of the essential knowledge for the science of animal life, the aims of the zoologist are similar to those of the medical physiologist, and he must follow similar methods. Dr. E. S. Russell agreed with earlier speakers in regarding zoology as the science of animal life, and stressed the necessity in such a science of returning to the earlier conception of the animal as an organism and discarding the analytical outlook which originated with the development of the cell theory. Prof. E. W. MacBride also accepted the study of animal life as a definition of the aim of zoology. He emphasised the importance of habit in the life and evolution of animals and therefore in zoological science. In the afternoon, several members of the association demonstrated applications of photographic methods to biological research. Mr. F. S. J. Hollick described an apparatus for recording the movements of insect wings in flight and the air currents set up by their movements, while Mr. A. G. Lowndes gave an account of his most recent methods of photographing the movements of small animals by means of an instrument in which the stroboscope and cinematograph are combined.

Cancer Research

AT the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on January 14, the following additional grants for 1935 were approved: £200 to Dr. Ralston Paterson for the part-time services of a radiologist at the Holt Radium Institute, Manchester; £250 to the Strangeways Research Laboratory, Cambridge, for the services of Dr. A. Glucksmann; £200 to Dr. Edith Paterson, at Manchester and £1,000 to the Radium Beam Therapy Research for the salary of qualified research workers. The Scientific Advisory Committee has been allotted a sum of £500 for the year 1935 for the salary and expenses of a research worker to carry out, under its supervision, an investigation of the action of radiation on colloids. The National Cancer Association of South Africa, which is representative of the research organisations of the Cape, Transvaal, Natal and Orange Free State, has been approved as a body affiliated to the British Empire Cancer Campaign. The Ottawa correspondent of *The Times* states that Canada will commemorate the twenty-fifth anniversary of the accession of King George to the throne by establishing a national fund for a campaign against cancer in Canada.

Decreasing the Number of Motor Accidents due to Skidding

CONCLUSIONS on this topic arrived at by Prof. R. A. Moyer, of Iowa State College, as set out in a paper read to the Highway Research Board, have been reported by Science Service, Washington, D.C. An exhaustive study of the skidding characteristics of motor-car tyres on various types of road surface indicates that the most important anti-skidding factor on the highway is to cover its surface with gritty particles so that it acts like sandpaper. The marked increase in the speed of vehicles on highways has led to a serious problem. The coefficients of friction between road surfaces and rubber tyres become smaller as the speed increases, and so skidding becomes easier. All stopping distances and centrifugal forces on curves increase as the square of the speed; that is, if the speed is doubled the shortest possible distance for stopping is increased four times and the necessary road friction is also increased four times. Highway engineers have been considering the possibility of building curves in spiral transmission fashion when the speed exceeds fifty miles an hour. In fast driving, in order to negotiate curves, the driver finds it easier to move from one side of the road to the other, but on blind curves this is a danger to approaching cars. Engineers are considering the possibility of building curved roads of such a shape that this tendency of drivers of fast cars may cease to be a menace to cars coming in the opposite direction. Prof. Moyer also points out that the application of the brakes when the car is going round a curve increases the tendency to skidding sideways but that the application of power decreases this tendency. For uniform braking the distribution of the load should be such that more weight falls on the back wheels than on the front wheels.

Position of the American Negro

RACIAL unity, racial pride and racial traditions have been of late subjects of discussions in which passion and prejudice have been more conspicuous than exact knowledge. From Vanderbilt University, Nashville, Tennessee, one of the smaller privately controlled universities of the United States, we have received a volume of abstracts of theses presented during 1933–34 by candidates for advanced degrees and, among them, a study by a candidate for the doctorate of philosophy of a movement for fostering these elements of culture among a 'non-Aryan' group, namely, the American Negro. It seems that since towards the close of the nineteenth century a sustained effort to develop race-conscious feeling so as to achieve "the internal unity and sentimental solidarity necessary to give the race a life more or less separate from other groups" has accompanied a vigorous struggle for recognition and status. Especially in the five years 1910–15, the aims and purposes of the movement became definitely established, a recognised leader emerged and formal machinery for its further promotion was created. At the present time, extensive provision is made by Negro colleges and universities for courses of instruction in Negro life and history, and numerous activities have developed outside the class room designed to make students better acquainted with Negro tradition: pageants depicting Negro progress and achievement, essay competitions, the celebration of Negro History Week, exhibitions of Negro art and literature and music festivals featuring Negro folk music. By making his history and tradition extensively known outside the community, it is assumed that the Negro will gain a larger measure of recognition and respect from the world at large for his worth and capacity.

History and Uses of Paraffin Wax

IN his paper read before the Institution of Petroleum Technologists on December 11, 1934, on the "Utilization of Paraffin Wax and Petroleum Ceresin", Mr. P. G. Higgs outlined the history of petroleum wax from its discovery in 1830 to its production on a commercial scale. Its use for a long time was restricted, since combustibility alone of all its useful properties was universally acknowledged as of market value. Time has shown, however, that paraffin wax can be used in cases where its characteristics of resistance to water, inertness, good electrical properties, etc., are invaluable. Thus to-day, apart from its chief function as an illuminant, it is employed, for example, as a proofing agent for porous materials, in the manufacture of waxed paper and paper boards, as an external coating to wooden receptacles for the preservation of foodstuffs, as an ingredient of polishes and in the electrical industry for insulating purposes. In addition, it is used in the form of an aqueous emulsion in the sizing of paper, as a size in the weaving of cotton, and as a glossing agent in the laundry trade.

PETROLEUM ceresins, the most recent addition to the range of paraffin waxes, are characterised by a relatively high setting point and micro-crystalline structure. Experiments have shown that the addition of 0·3 per cent or less to commercial paraffin wax alters the structure of the whole practically to micro-crystallinity. Moreover, in the case of candles made from paraffin wax to which a similar small percentage of ceresin has been added, resistance to bending is substantially increased. Initially, the strong colour of petroleum ceresin was a disadvantage in this connexion, but this is overcome by incorporation of the ceresin during the manufacture of the paraffin wax and refining the two together. The resultant product, while having a pleasing colour, also lacks, or has in a much lesser degree, the defects usually consequent on marked crystallinity of the paraffin wax. It is reasonable to suppose, therefore, that the usefulness of paraffin wax could be still further extended by the addition of small quantities of petroleum ceresin. Whether it is better to manufacture 'doped' waxes or leave the 'doping' process to the user is, however, still an open question.

Water Purification by Ozone

IN *Engineering* of January 4, Mr. T. Rich gives an account of the development of the treatment of water by ozone which has resulted from the researches made by P. Otto in 1898 in connexion with his thesis for a doctor's degree at the Sorbonne. When Dr. Otto was carrying out his experiments, the question of potable water supplies in France was becoming a matter of concern, and, encouraged by Pasteur, he took up the design of ozone water sterilisation apparatus for outputs varying from that through a single tap to that required for large cities. One of the first important installations laid down to his designs was that for Nice, and since this was constructed many other places on the Riviera have followed the example of Nice, owing to serious outbreaks of typhoid. In 1932, the scientific commission for the study and control of the water supply of Paris decided to supersede the use of chlorine by the use of ozone for treating water taken from the Seine and the Marne, while quite recently an important ozone-sterilisation plant has been put into commission for the water supply of Nancy, a manufacturing city of 120,000 inhabitants. There are other plants in operation in Belgium, Italy, Rumania and on the Congo, and the system has been applied to the water supply of large passenger vessels. The principal apparatus in a plant is the electrically-worked Otto ozone generator, and of this Mr. Rich gives a full description.

Grey and Red Squirrels in England

IN the report on animal numbers, issued by the Oxford University Bureau of Animal Population at the end of 1934, the director, Mr. A. D. Middleton, states that the evidence from the Bureau's three hundred or so observers in various parts of Great Britain points to another serious increase of the American or Carolina grey squirrel (*Sciurus carolinensis*, Gmelin) and also an increase of the native British red squirrel (*Sciurus leucorous*, Kerr) after the setback due to disease outbreaks of a species of *Eimeria* (Coccidia) noted in 1931. During the last three years, the report points out, the British red squirrel seems to have been steadily regaining its former status in most parts of the country and is now commonly seen in many districts where the American grey squirrel is not present Even within the area occupied by the grey squirrel, red squirrels have frequently been seen during the past two years The American grey squirrel, after its severe setback in 1931, due mainly to disease, was in comparatively low numbers during 1932 and 1933, but there are now many indications that a period of increase is well on the way It has gradually extended its range, spreading outwards from the main areas previously occupied (home counties, Midlands, Central Yorkshire, Cheshire, North Wales, Dumbartonshire, Fife and the environs of Bournemouth, Exeter and Edinburgh); several have been found in an isolated wood near Woodbridge, in Suffolk "Should the numbers increase greatly over this large area," adds Mr Middleton, "it seems probable that the grey squirrel may become of more serious economic importance than hitherto" The Oxford University Bureau is now extending *its national* investigations of animal numbers to the Japanese deer (*Cervus sika*) which have escaped from many English parks and taken to living wild in the woods of the home counties and the south, and of harvest-bugs (*Trombidiidae*)

Scientific Correspondence of Sir James Smith (1759–1828)

The main portion of Part 1 of the Catalogue of Manuscripts in the Library of the Linnean Society of London is devoted to the scientific correspondence of the first president of the Linnean Society, and Mr. Warren Dawson has abstracted the more important matters referred to in more than 3,000 letters received by Sir James Edward Smith (1759–1828) (Catalogue of the Manuscripts in the Library of the Linnean Society of London, Part 1 The Smith Papers The Correspondence and Miscellaneous Papers of Sir James Edward Smith, M.D, F R S, First President of the Society By Warren R Dawson, F R S E Pp 114. London The Linnean Society, 1934 10*s* net) It is a careful piece of work, the completion of which confers a benefit on all who are interested in the natural history of the period immediately following Linnæus's death, and the transference of his collections to England six years later The correspondents include many distinguished naturalists both at home and abroad, and some of their letters are valuable documents from the point of view of the history of biology Sir James Edward Smith was primarily a botanist, but as possessor of Linnæus's collections for about forty-five years he had wide interests as a naturalist He was one of the founders of the Linnean Society of London, his co-founders being the Rev. Samuel Goodenough, afterwards Bishop of Carlisle, and Thomas Marsham, an entomologist

International Aspects of Drug Addiction

In the Norman Kerr Memorial Lecture on this subject published in the January issue of the *British Journal of Inebriety*, Sir Malcolm Delevingne, late Deputy Permanent Under-Secretary of State and British representative on the Opium Advisory Committee of the League of Nations, showed that the international treatment of the problem during the last fourteen years has afforded a striking example of what can be accomplished in a difficult field by international co-operation, aided by the machinery of the League of Nations. After a historical sketch of the subject with special reference to the conferences at the Hague and Geneva, he dealt with the present position, showing that a system of control over the export and import trade is in operation, which if universally and effectively adopted is practically watertight The illicit traffic however still continues to flourish, owing to a resort having been made to clandestine sources of supply or to parts of the world where control is less strict or non-existent In dealing in conclusion with the medical and scientific aspects of the problem, Sir Malcolm briefly alluded to the treatment and after care of the addict, the possibility of replacing the drugs wholly or partly by less dangerous substances, the rate of consumption of the drugs in different countries, and the question as to whether new drugs are habit-forming or not

Engineering Research in Japan

In vols. 10 and 11 of the *Japanese Journal of Engineering* recently issued by the National Research Council of Japan (Imperial Academy House, Veno Park, Tokyo), abstracts of varying length are given of some 400 papers on civil engineering, naval architecture, technology of ordnance, electrical engineering, mine engineering and metallurgy The abstracts are printed in English, and about three-quarters of them relate to various aspects of electrical engineering. Some of the papers have been contributed to the Institution of Electrical Engineers of Japan, while others contain reports of researches carried out at the Electrotechnical Laboratory, Ministry of Communications, Tokyo, and at research institutions and universities Corresponding journals issued by the National Research Council contain abstracts of papers on astronomy, chemistry, physics, botany, zoology and other branches of science

Contour Maps of the East

Among the latest additions to Bartholomew's General World Series are maps of the Middle East (Persia, Iraq, Palestine, Syria, Turkey and North Arabia) and the Far East (China, Japan, Korea and Manchukuo) on scales respectively of 1 : 4,000,000 and 1 : 6,000,000 The maps are contoured and layer-coloured in green, brown and purple. Political and provincial boundaries are clearly marked, and on the map of the Middle East the chief roads, routes and caravan tracks are shown, as well as airports All railways and the principal steamer routes are given. The scale allows a considerable amount of detail and a large number of names. The printing is clear, and the maps should prove most useful. The price of each map mounted on cloth and folded is six shillings

The *Cape Naturalist*

IN November there appeared the first number of the *Cape Naturalist*, which is designed to increase the interest of non-technical readers in Nature and archæology in South Africa A striking cover reproduces the flower of *Stapelia*, the colour and carrion like odour of which attracts blowflies which pollinate the flowers, and sometimes, deceived by the smell, deposit their eggs upon the petals The articles are short and varied enough to make a general appeal (Pp 24, price 7*d* post free, from Mrs Stephens, Alma Road, Rosebank, Cape Town) The magazine is issued by the Cape Natural History Club, and should it meet a demand it will be issued quarterly, or possibly in time monthly

International Hospital Congress

THE Fourth International Hospital Congress, which has been organised by the Italian Government, will be held at Rome on May 5–12, when the following subjects among others will be discussed the hospital as part of a system of public health , the equipment and technical installation of hospitals , the work of the hospital and its protection in times of disaster The Congress will be preceded by a tour of inspection of some of the large towns in northern Italy, and be followed by excursions in southern Italy, Sicily and Tripoli Further information can be obtained from the International Hospital Association, Lucerne, Switzerland

First Comet of 1935

A MESSAGE published in *The Times* of January 10 announces that a comet has been discovered by Mr E L Johnson of the Union Observatory, Johannesburg This comet will be called Johnson's comet, 1935*A* The comet is presumably faint Some half dozen faint comets are seen every year For example, in 1933 there were six, ranging in magnitude at brightest from 8 to 18 (this was the faintest comet which has yet been observed) Of these, three were periodic and recognised as returns of known comets. It is some years since a notable, naked-eye comet appeared

Scientific Meetings in Australia

MANY of the Australian scientific societies have arranged meetings for January in Melbourne, the natural centre during its centenary celebrations for conferences and congresses of all kinds. The Australian National Research Council hold its annual session on January 15, when important questions of future policy were debated It has been suggested that its scope be altered somewhat, and that it take the title of Royal Society of Australia, recently bestowed on a smaller scientific society established at Canberra On January 16–23 the Australian and New Zealand Association for the Advancement of Science is holding its biennial meeting under the presidency of Sir Douglas Mawson Public addresses are being delivered by Dr. P. Marshall on volcanoes of the Pacific and by Sir George Julius on certain aspects of the unemployment problem. Sir David Orme Masson is giving the Liversidge Memorial Lecture to Section B on crucial advances in chemical theory during the last half century Immediately following these sessions, the half-yearly meeting of the Council for Scientific and Industrial Research will take place while many minor societies and groups of workers are arranging gatherings for discussion of matters of common interest

Announcements

THE Council of the Physical Society has awarded the twelfth Duddell Medal to Dr W Ewart Williams, lecturer in physics at King's College, London

WE regret to announce the death, on January 13, of the Rev S. A McDowall, chaplain and senior science master at Winchester College, aged fifty two years

THE Huxley Memorial Lecture of the Royal College of Science, South Kensington, for 1935 will be delivered on May 6 by Sir Henry Dale, director of the National Institute for Medical Research, who has chosen as his subject "Viruses and Heterogenesis an old Problem in a new Form"

THE following appointments have recently been made by the Secretary of State for the Colonies Mr M W Gibbon, Mr J R Miller and Mr E W. Momber, to be superintendents of agriculture, Nigeria , Mr W F Baldock (assistant conservator of forests), to be senior assistant conservator of forests, Tanganyika , Mr C B Bisset (assistant geologist, Nyasaland), to be field geologist, Uganda , Mr A de K Frampton (agricultural superintendent, British Guiana), to be agricultural officer, Straits Settlements and Federated Malay States , Mr G L R Hancock (assistant entomologist, Agricultural Department), to be biologist, Makerere College, Uganda , Mr E F Peck (veterinary officer, Nigeria), to be veterinary and agricultural officer, Somaliland , Mr C Smith (deputy conservator of Forests, Federated Malay States), to be conservator of forests, Johore , Mr A J Wakefield (senior agricultural officer), to be deputy director of agriculture, Tanganyika

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An agricultural lecturer and warden at the Kent Farm Institute, Borden, Sittingbourne (Jan 21) Teachers of science subjects and mathematics and engineering at the Willesden Technical College—The Secretary, Willesden Local Higher Education Committee, Education Office, Dyne Road, Kilburn, N W 6 (Jan 25) A head of the Junior Technical School for Boys, North-Western Polytechnic, Prince of Wales Road, Kentish Town, London, N W 5—The Clerk to the Governors (Jan 31). A veterinary pathologist in Malta—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W 1 (Jan 31) An assistant entomologist at the Rothamsted Experimental Station, Harpenden, Herts—The Secretary (Feb 15) A professor of botany in the Egyptian University, Abbasia, Cairo—The Dean of the Faculty of Science (March 15).

Research Items

Queensland Aborigines. Further notes on the aborigines of Princess Charlotte Bay, North Queensland, have been published by Messrs Herbert M Hale and Norman B. Tindale (*Rec S. Austral Mus*, vol 5, No 2) A study of the language and vocabularies of four tribes are included Two types of canoe are in use, one in which a single outrigger is placed on the starboard side, and the other a double outrigger The canoes are made from trees hollowed out, formerly by axes of stone, and the outriggers are supported by booms In the first, the booms are lashed to crossed sticks which are attached to the outrigger, in the latter the booms are directly attached in pairs to each outrigger The view held by Roth that the single outrigger is a local modification of the double is not accepted It is thought that they are both due to external cultural influence, differing in time. The camps are both temporary and semi permanent The former may be constructed by small parties when away hunting Their shelters differ considerably from those which are erected in the semi permanent camps and may be occupied for weeks or even months. The temporary shelters are semicircular, and *only four or five feet in diameter.* They are formed of a framework of thin saplings, on which strips of bark are laid Leafy boughs afford additional shelter from the sun In the more enduring form, the huts are larger and higher. They are built in a rounded dome-shaped form with a circular base about ten feet in diameter Bark completely covers the framework, except for the small doorway only twelve or sixteen inches in height The bark is covered with thick tussocks of grass This affords efficient shelter from all but the heaviest rains The only shelters to which the term 'permanent' can properly be applied are caves and rock shelters These are occupied by large bodies of natives for long periods, especially during the wet season The surfaces of large rock shelters usually bear a number of paintings, many representing animals and other objects, which can readily be identified

Ecology of a Bahaman Fresh-Water Lake. An interesting research by Mr C M Breder, Jr, "Ecology of an Oceanic Fresh-water Lake, Andros Island, Bahamas, with special Reference to its Fishes" (*Zoologica*, **18**, No 3, 1934) is the result of short expeditions in January 1932 and 1933 This island represents a certain ecological condition that should be of particular interest to biologists It is truly oceanic and of coral reef formation The fishes in Lake Forsyth have already been listed (Breder 1932) and are the only vertebrate group which may be considered abundant. They are all typically marine, or at least brackish-water forms, and are apparently entirely supported by the dense beds of the peculiar brackish and hardwater plant *Batophora* flooring the bottom of the lake, or by the microscopic or nearly microscopic organisms living on its fronds, a certain number being predaceous and feeding on the former. The fish population *in such fresh-waters* as those on Andros Island may be accounted for by their ability to withstand fresh-water in which a sufficient amount of calcium *is* present The few invertebrates present are mostly fresh-water forms, marine invertebrates in general not sharing the adaptability of the fishes and being much more susceptible to slight chemical changes "Lake Forsyth may be considered as representing a 'new' fresh-water environment in which invading forms are just commencing to establish themselves Various gradations from this condition backward to purely marine conditions are represented in other Bahama Islands, Andros Island representing the most advanced position chiefly because of its greater drainage area."

Fish Gills Specialised for Oxygen Deficiency. Accessory respiratory organs in fishes are somewhat seldom, and then in a secondary sense, related to living out of water In all fresh-water fishes with such accessory structures, the development of the structures has been correlated with existence in oxygen-deficient water, as Carter and Beadle notably showed for the inhabitants of the Gran Chaco swamps Gerrit Bevelander has examined *Amia* from this point of view, and notes that the gills are in many respects different from those of other fishes. The lamellæ are highly modified into sieve plates, which are presumably highly efficient in absorbing oxygen under low tension, and possibly serve also in atmospheric respiration (*Copeia*, p 121, 1934) He suggests that this specialisation is correlated with continued existence and activity in stagnant marsh waters, which would explain not only the habitat selection displayed by *Amia*, but also the survival of this 'living fossil' into present times.

Digestion of Wood by Insects. Since Lyonet in 1762 carried out the first crude experiments designed to discover how wood is digested by insects apparently feeding on it, a large number of investigators have attacked this fascinating problem. The history of these researches and the latest conclusions are very concisely surveyed in a recent paper by K Mansour and J J Mansour-Bek (*Biological Reviews*, 9) The main conclusion is that the rôle in the digestion of wood of intracellular micro-organisms, often present in xylophagous insects, is not so important as was thought by many authors, particularly by Buchner and his school Indeed, some wood-eating insects proved to be free of micro-organisms and yet able to survive on a wood diet, being able to secrete cellulose The micro-organisms of others have been cultivated *in vitro*, and found to be unable to break down cellulose In wood-eating termites, the intestinal Infusoria are utilised as a direct source of food, so that these insects should be classified as feeding on micro-organisms, not on wood Many true wood-eaters do not depend upon cellulose and have no cellulase, but utilise starch and soluble sugars in the wood. Nitrogen is obtained probably from proteins which are practically always present in wood, while proteolytic enzymes have been found in most wood-eating insects. This makes superfluous the assumption that micro-organisms fix atmospheric nitrogen for the use of their host

Wood Anatomy and Angiosperm Origin. Prof. G. R. Wieland has an interesting discussion from the palæobotanical point of view of recent contributions bearing upon this problem in "Tropical Woods" of 1934, the journal published by Prof. Record of Yale University. He deals especially with the new *investigations* of Hagerup, in which developmental studies have been made of the conifer inflorescence by the method of serial sections. These researches have strengthened the view that the conifer phylum, including both *Pinus* and *Araucaria*, is a very homogeneous group. But Wieland dissents from the view that it is a necessary conclusion that the main source of the Angiosperms has to be found along a line from Conifers to Gnetales to Piperaceae and Juglandaceae. He recalls again the anatomical resemblances between the Cycads and the Cycadeoids which have been his own main interest, and the Angiosperms, especially those vessel-less members, the Homoxyleæ of van Tieghem which are again coming into the forefront of botanical interest. Gupta's recent review of the homoxylous woods is examined, but Wieland dissents from his tendency to put *Magnolia* and Cycadeoid into parallel rather than convergent lines. Wieland still evidently sympathises with Lemesle's conclusion (*Rev. gen. de Botanique*) that the Magnoliaceæ are very ancient as compared with other Angiosperms (Lemesle regards the group as showing clear transition from scalariform tracheids to vessels) and that the 'Cycadeoid theory' of Angiosperm origin must still be reckoned with.

Cold Weather Planting in Northern India. In Forest Bulletin No. 86, "Cold Weather Planting in Northern India" (Delhi: Manager of Publications, 1934), Mr. H. G. Champion, sylviculturist at the Research Institute, Dehra Dun, deals with the planting problem in the United Provinces. Except where irrigation is an economic proposition, practically the whole of plantation work has to be done at the break of the rains, when the necessary labour is usually very difficult to procure and, even if obtained, is very liable to leave the work or be largely incapacitated by malaria and other complaints due to the general dampness, and to the unsatisfactory condition of the drinking water. After an allusion to the *taungya* methods of obtaining new crops, which are proving in some cases so great an assistance, Mr. Champion says that were it possible to do any appreciable part of the work in the cold or early hot weather, it would be most advantageous. Cold weather work would be of value because, for nearly all species, the most rapid growth occurs in the first week or two of the rains, or even before the monsoon has set in definitely enough for most planting work. This period is lost if the plants are only recovering from transplantation or the planting out work cannot all be completed in the very few early favourable days. This is an interesting comment since experiences in West Africa, under rather different conditions, are pointing in the same direction. The bulletin describes experiments made between 1927 and 1932 at Dehra Dun on planting out entire plants or stumps of thirty-three tree species after good winter rain, and a few trials of planting at regular intervals throughout the cold weather. As would be expected, the results varied greatly with the amounts of rainfall during the year of experiment, but very few species proved satisfactory. Teak stumps planted in March in the shade give good results provided the monsoon is not delayed, which has happened only twice in the period at Dehra Dun, but they may succeed in most years in more favourable localities.

The Alkali Metals. H. Alterthum and R. Rompe have prepared (*Phys. Z.*, Oct. 15, 1934) a long summary of work done on the alkali metals in the years 1930–33. The summary includes nuclear properties: atomic weight, mechanical and magnetic nuclear moments, natural and artificial nuclear disintegration; electronic properties of the atoms and molecules, including spectroscopic data, fluorescence and gas-discharge work; chemical, electrical and optical data of the dispersed and of the massive metals. There is a special section on laboratory methods for the preparation of the pure metals. The lists of references given should be extremely useful to those working with these metals.

Non-Linear Mechanics. Three monographs on this subject, by Prof. N. Kryloff and Dr. N. Bogoliuboff, have been published at Kieff by the Academy of Sciences of the Ukraine, making a total of seventeen published there or elsewhere since 1931. Some are in French or German; those in Russian or Ukrainian usually have a French summary. The general problem is the solution of differential equations relating to motion which is approximately simple harmonic, but not exactly so. It is closely related to H. Bohr's theory of almost periodic functions, that is, of functions having no periods in the strict sense, but having an unlimited number of them to any given degree of approximation. However, the Russian authors are not, like Bohr and many others, concentrating on the purely mathematical and functional aspect, but are developing it from the point of view of differential equations and their physical interpretations. Among the wide range of their applications may be noticed astronomy (celestial mechanics), engineering (vibrations of synchronised machines), aviation (longitudinal stability of aeroplanes), and radio-telephony (properties of radio valves). They show that a phenomenon analogous to the Raman effect, which is usually regarded as explicable only by quantum mechanics, can be explained by classical mechanics as a simple consequence of the equations of motion not being exactly linear.

Characteristic Solution of a Differential Equation. It is well known that an integral equation can be found equivalent to the system made up of a linear differential equation and certain boundary conditions, and that the appropriate Green's function of two variables is closely connected with either system. A method of finding an integral equation corresponding to a differential equation without boundary conditions is now given by H. Nakano (*Japanese J. Math.*, **11**, 1934). Again a function of two variables plays an important part. It is called the characteristic solution, but it must not be confused with the characteristic functions (of one variable) arising from a differential equation involving a parameter. The characteristic solution, unlike the complete primitive of the differential equation, contains no arbitrary constants; but if either is known the other can be easily obtained. Usually, of course, both are unknown, but we can obtain a certain amount of information about the characteristic function by means of an integral equation which can be set up in terms of the functions occurring as coefficients in the given differential equation. The author imposes severe restrictions upon these coefficients, and one wonders whether the methods could not have been extended so as to include an investigation of singularities. The later part of the paper applies the properties of characteristic solutions to a certain class of differential equations called *volleigentlich*, which may perhaps be translated as 'wholly proper'.

Geographical Studies and Teaching

GEOGRAPHICAL ASSOCIATION

THE annual meeting of the Geographical Association was held at the London School of Economics on January 2-5. Lord Meston in his presidential address dealt with the "Geography of an Indian Village", referring particularly to his own experience as a settlement officer in the United Provinces in the early days of his service in the Indian Civil Service.

This careful description of the work of a settlement officer has a great importance as illustrating the use of a thorough local geographical study as a basis for property valuation, taxation and local administration. When the assessment or reassessment of a District (using that term in its Indian sense as meaning an administrative unit, commonly 1,000-3,000 square miles in area) becomes necessary, the work, which is likely to occupy three or four years, is entrusted to a 'settlement officer'. He starts by securing a general view of the whole area, and in the careful descriptions prepared there exists, hidden away in Government offices throughout India, a vast store of unpublished material of great geographical value. He then undertakes systematically the survey of each village—a 'village' designating the tract of land (in the United Provinces commonly 50-1,000 acres) round the hamlet or residential centre. A base map—usually on the scale of 16 inches to one mile—is prepared either by the Survey of India or by an *ad hoc* survey party controlled by the settlement officer. Each field is numbered and a description of it made by the village accountant. The record includes the character of the soil, crops, ownership, occupation, taxable value and taxes paid. The soil classification commonly used is into black cotton soil, first-class loam, second-class loam, sandy loam, sand, gravel and uncultivable. It is not perhaps fully realised that there exists for practically the whole of settled India this accurate soil and land utilisation survey.

The nucleus of the older type of Indian village in the United Provinces is usually the ancestral home of the chief landowner surrounded by its mud wall. Around it is an irregular ring of houses—arranged with very little planning and no sanitation, then the hovels of the depressed classes. The village pond, which serves as a public bath for man and beast as well as for a supply of drinking water, completes the picture. Surrounding the hamlet is a ring of richly manured land but which, because of the source of its manure, is only cultivated by the depressed classes, and then finally the arable land of the villagers. Reference was made by Lord Meston to changes in soil and soil values which are tending to result from the extension of irrigation—including the impoverishment consequent upon the accumulation of alkali.

Two sessions of the Association were held in conjunction with the Le Play Society. At one, Mr. A. E. Moodie gave an account of studies carried out in the Stubaital in the Austrian Tyrol. At the other, under the chairmanship of Sir John Russell, the leader of the party in the field, three short papers were presented on Russia. Mr. R. A. Pelham gave a historical introduction, Dr. A. S. J. Baster, an economist's view, while Mr. Leonard Brooks gave a fascinating account of recent educational developments. He emphasised the central place that the factory occupies in the life of a community and that, like other activities, the school is attached to it. As vocational education, the system is good in the essentially close contact which is maintained. The children are given a conspectus of the whole working of the factory, and can afterwards take their places in different parts of the works. Similarly, the university has almost entirely given place to specialised technical research or training institutions. There are already signs, it would appear, of the desire to return to a more general educational system, at least in places, but the general progress in literacy made in the last five years is so amazing as to be almost incredible.

Dr. G. P. Gooch in his address on "Geography and International Problems" indicated clearly the importance attached by historians to the geographical background, but at the same time illustrated the need for closer co-operation between specialists. His sketch of the geographical background of China could not possibly be accepted by geographers, nor could his description of the Saar.

Dr. Dudley Stamp in his lecture on "Planning the Land for the Future" referred particularly to recent studies in land utilisation in the United States. At present, out of a total area of 3,000,000 square miles, the proper use of roughly a third is not yet decided. For the best types of land in the country—for example, the belts of good soil in the Middle West—it is clear that they must remain in agriculture. Similarly, for the poorest lands the proper use is clearly desert, forest or grazing. The problems arise in areas of intermediate value. Amongst the reasons for existing mal-utilisation of land some of the chief are: (*a*) those consequent upon the history of settlement—the clearing of poor land in the East before the better land was discovered; (*b*) the ravages of soil erosion; (*c*) the development of communications throwing all areas into ready contact and rendering cultivation in poorer tracts uneconomic; (*d*) 'over-production' of agricultural commodities consequent upon technical progress combined with diminution of foreign trade; (*e*) the depletion of forest lands, and (*f*) social changes—the need for more land for recreation or for semi-subsistence cultivation. A summary was given of work undertaken, especially under the Roosevelt administration, to combat the difficulties. Of the varied planning schemes, those based on the economic needs of the moment are fraught with danger; those based on a careful investigation of the potential capacities of the land are working on a sure foundation.

Among the interesting lectures of a general nature must be mentioned that by Brigadier H. St. J. L. Winterbotham on the history of the Ordnance Survey, Dr. Bernard Smith on water supply and Dr. Allen Mawer on place name study.

INSTITUTE OF BRITISH GEOGRAPHERS

The formation of the Institute of British Geographers was recorded in NATURE of January 14, 1933, and the Institute held its third annual meeting at the London School of Economics on January 1 and 4 of this year.

Dr. H. A. Matthews dealt with the "Seasonal Distribution of Rainfall in the Mediterranean Region of California" by a careful analysis of dispersion diagrams The results, in this area, confirm the general simplicity of the regime and do not therefore add greatly to the information obtained by using mean monthly rainfall values, but a clear demonstration is afforded of the value of a logarithmic scale in plotting seasonal variation Variability of monthly precipitation increases markedly (*a*) from north to south and (*b*) from lower to higher elevations

Mr E G Bowen showed the results of attempting to map the 'spheres of influence' of the missionary saints of the Dark Ages, choosing St Samson and St Columba, in Celtic Britain These spheres seem to coincide with cultural provinces determined on the basis of archæological distributions, but in the discussion various reasons were suggested for this Mr K H Huggins's paper on "Types of Settlement in the Scottish Highlands" was concerned to a considerable degree with the delimitation of the Highlands' as distinct from the 'Lowlands' By using such criteria as structure, elevation, 'amount of relief', proportion of moorland, type and density of settlement, different 'limits' to the Highlands are obtained, and there is clearly a central area where all the Highland characteristics are present, fringed by a broad transitional area

Mr K C Edwards dealt with the consequences of recent improvements in the River Trent as a waterway—including the growth of Nottingham as a leading distribution centre for petroleum products

The distribution of settlements, permanent and temporary, and of cultivated crops in Alpine valleys, is a subject of considerable importance and concerning which there is an extensive literature But an important advance in knowledge is marked by Miss Alice Garnett's careful and suggestive study of insolation A formula for the calculation of insolation intensity at any given spot (based on slope, aspect and the sun's elevation) has been devised and it is possible to construct 'intensity maps' Special importance is attached to spring noonday intensity values At the same time 'time periods of insolation' are mapped and the results are combined.

This method of investigation seems to demonstrate a possible law of alpine settlements, namely, that above *c* 1,100 m , all permanent settlements avoid the areas of winter shade, while *ubac* villages follow the *edge* of the winter noonday shadow line For regions studied in lat 46° N , above 1,400 m , wheat, barley and rye require at least an 80-90 per cent spring noonday intensity Wheat can ripen up to c 1,600 m. where a noonday equinox intensity *exceeds 90–95 per cent of the maximum possible* at that time, provided these areas also have long time periods of insolation Areas with a 50-70 per cent intensity are generally given over to meadow, while land with an intensity value of less than 50 per cent is left to forest It is abundantly clear that this study has an important bearing on land planning in alpine areas and is capable of extension to regions of lower relief in higher latitudes—for example, to the Highland valleys of Scotland and Antrim, where the intensity and time period of insolation would seem to have a bearing on health problems

Dr S W Wooldridge, by a preliminary analysis of areas in the London basin, dealt with the 'facet' as the ultimate unit of geographical analysis The facet is difficult of definition though the concept is clear A river terrace, a dip slope, a plateau (even if only a fragment) are 'facets' which thus correspond in general with geomorphological units, but in detail have different boundaries Thus the 'Taplow Terrace facet' as a geographical unit does not coincide with the distribution of the Taplow Terrace gravels of the geological map

The last session of the meeting was devoted to a discussion of Prof C B Fawcett's paper on the relations between the advance of science in geography and the life of the community, read before the British Association at Aberdeen in September last.

The Institute, in accordance with its avowed policy of publishing memoirs too long for inclusion in existing periodicals but unsuitable for publication in book form, has issued, as its first volume, Dr R O Buchanan's study of the pastoral industries of New Zealand

L. DUDLEY STAMP

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W C 1, on January 7–8, under the presidency of Prof E H Neville, of the University of Reading The following distinguished mathematicians were elected honorary members of the Association · Profs E. Borel (Paris), J Hadamard (Paris), G H Hardy (Cambridge), D E Smith (New York), E. T Whittaker (Edinburgh) Mr. A W. Siddons, of Harrow School, was elected president of the Association for the forthcoming year

In his presidential address, entitled "The Food of the Gods", Prof Neville dealt with a problem in mathematical education which is of considerable importance and difficulty. From the fact that the preparation given to a schoolboy a quarter of a century ago for an entrance scholarship examination at Cambridge would be adequate to this examination as it is at present, while the undergraduate of those days would find many of the questions in a modern tripos incomprehensible, he deduced that the universities of to-day build a different mathematical structure, but are content to build it on foundations which have not changed since the beginning of the century Since this difference is due to the direct influence of changes in emphasis in creative mathematics on the teaching at the universities, he urged that such changes ought to have a greater and far more rapid influence on teaching at the schools than they seem to have. Room for new ideas can only be found by omissions or condensations, by the expulsion from the curriculum of methods and ideas once valuable but now outworn, kept in place through inertia To demonstrate the possibility of such a reform, Prof Neville gave some examples illustrating the successful working of a similar process at the undergraduate stage. To bring this about at the school stage, the young teacher has the knowledge of what is important, the old teacher has the experience of what is practicable and the influence to effect the changes he desires, and Prof. Neville sees in this an opportunity for the generations to co-operate At present, each advance is followed by a score of years in which the backward schools and the popular textbooks creep up to the leaders , he envisages a responsiveness everywhere to the ferment of current ideas, which should result in a mathematical nourishment requiring no long periods of accommodation, the true 'food of the gods'.

Following the presidential address, Brigadier H. St. J. L. Winterbotham, Director-General of Ordnance Survey, spoke on "Geography and Mathematics", detailing the many and various ways in which a knowledge of mathematics assists geographical progress.

Of the four papers which occupied the morning of January 8, that which attracted most attention was given by Mr. C. L. Parsons, of Merchant Taylors' School, under the title "The Work of a Junior Mathematical Association". The members of this Association are some eight public schools in the London area; five meetings are held each year, and a good attendance of the mathematically minded pupils in the higher forms of these schools is obtained. Occasionally the meetings are addressed by distinguished adult mathematicians, but more frequently by the boys themselves, who are thus encouraged in habits of independent thought and research. Sir James Jeans is the president of the Association, and the president's annual essay prize attracts many excellent entries.

In the afternoon, Prof. D. R. Hartree, of the University of Manchester, gave a paper on "The Bearing of Statistical and Quantum Mechanics on School Work"; after asserting that the new mechanics has no direct bearing on school work, he explained in elementary terms some of the basic concepts of the subject in such a way as to illustrate the indirect influence the new ideas might be expected to exert on school work in mathematical physics. Following this, the warm interest which members of the Association invariably take in points of teaching practice was again demonstrated by a lively discussion on "The First Encounter with a Limit", in which teachers from the schools and universities took part. The meeting ended with a delightful lecture by Prof. G. H. Hardy on "The Theorem of the Arithmetic and Geometric Means", in the course of which he discussed several different proofs of the fundamental inequality connecting these two means, and incidentally directed attention to some very important, but much neglected, work by Dr. R. F. Muirhead on inequalities of a more general type.

Work of the Rothamsted Experimental Station

As knowledge of plant growth accumulates, the number of points from which the problem of crop production can be attacked increases. Since the foundation of the Rothamsted Experimental Station in 1843, the activities of the Station have been steadily extended so as to make it possible to follow up some of the new problems which are continually brought to light by the work there and elsewhere. The study of quality in crops, for example, has led to a considerable amount of work in conjunction with the Institute of Brewing, the Millers' Research Association, sugar beet factories, etc. The work on malting barley, for example, has outgrown the accommodation at Rothamsted, and, having reached the stage where closer contact with the brewing industry was necessary, has been transferred elsewhere.

The Rothamsted report for 1933* gives a brief summary of the various problems under investigation during the year at Rothamsted and Woburn, and also includes trials carried out at outside centres. Though the field and laboratory work are really one, they are, for the sake of convenience, dealt with separately in the report. The report includes results of some schemes of experiments conducted on a uniform basis at a number of centres; for example, results of ten years experiments with malting barley, and of experiments on the effect of fertilisers on the yield and quality of sugar beet. A list of papers published from the Station is also included, together with comments on the contents of each.

The problem of soil organic matter continues to receive attention, the plan of investigation being one designed and begun some years ago. This problem is important in view of the possibilities of mechanised cereal growing, and the Rothamsted experiment will help in answering the question which will inevitably be asked by those contemplating farming under the new conditions—how far it is possible to practise mechanised corn-growing and pay no attention to replenishing the stocks of soil organic matter by the addition of farmyard manure, sheep folding, etc. That the solution of this problem is not so simple as was once considered is gathered from the observation in the report that green manures do not keep up the productiveness for wheat of the light soil at Woburn, and that the residual values of farmyard manure and of cake and corn fed to animals at Woburn appeared to be much less than is indicated by the recognised tables. The latter observation has also an important bearing on the existing method of assessing certain compensations due on the termination of tenancies.

Dr. R. A. Fisher, who left in October 1933 to take up his new duties as Galton professor in the University of London, has written a short account of the contribution of Rothamsted to the development of the science of statistics. One development, namely, the realisation that it was necessary to treat the question of field procedure and that of statistical analysis as but two aspects of a single problem, has resulted in definitely increasing the value of experimental work. To quote Dr. Fisher, "By applying statistical methods not only to the interpretation but also to the design of experiments, it is not uncommon for the value of the experiment to be increased five or ten fold, a result which could not be obtained from improved methods of interpretation only". It is doubtful, for example, if the capacity of superphosphate and sulphate of ammonia for reinforcing each other's effect could have been detected and estimated if it were not for the improvements in plot technique and interpretation of results. The Statistical Laboratory has tackled the problem of technique in livestock trials, having commenced by a successful pig feeding experiment; the pens and feeding arrangements have been designed so that all types of rations are distributed equally over all the groups of pens instead of all the pigs on one treatment being in the same pen.

The report is essential for those engaged in teaching or research work. The long-term experiments and the thoroughness of the liaison between field and laboratory work give added value to the work at Rothamsted. The practical farmer will also find the report interesting, but most of the results will doubtless reach him through the medium of the agricultural Press.

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* Rothamsted Experimental Station, Harpenden. Lawes Agricultural Trust. Report for 1933. Pp. 200. (Harpenden: Rothamsted Experimental Station, 1934.) 2s. 6d.

University and Educational Intelligence

LIVERPOOL —Prof H H Read, George Herdman professor of geology, who has just been awarded the Bigsby Medal of the Geological Society of London, has worked largely on the geology of the Highlands He has made a number of important discoveries on the complicated region of lower Banffshire and north Aberdeenshire, and has just published a paper on the geology of Unst, in the Shetland Islands

EDUCATIONAL problems in India are, perhaps, more various and more baffling than in any other country, and among the most difficult are those of the education of the Anglo Indian child Also, at the present time, they are of peculiar urgency owing to the progressive limitation in recent years (and the prospect of still more drastic limitation in the near future) of the fields of employment open to the Anglo-Indian community and the simultaneous increase (from 1921 until 1931, 22 per cent) in their numbers some 20,000 who ought to be earning their living are actually unemployed A valuable and timely discussion of the subject is reported in the *Journal of the Royal Society of Arts* A paper read on November 9 before the Indian Section of the Society by the Very Rev J A Graham, honorary superintendent of St Andrew's Colonial Homes, Kalimpong, Bengal, describes what has proved to be an efficient enterprise for enabling needy Anglo-Indian children to develop into worthy members of society Beginning in 1900 with six children, it has grown into an educational colony in which 575 boys and girls housed in cottages are being trained for such occupations as agriculture, engineering, the railway, telegraph and forest services, business, teaching and nursing. In the course of the discussion which followed the reading of the paper, attention was directed to the recent inauguration of a ten thousand acre colony at Lapra in Bihar This was described as one of the most hopeful of projects hitherto tried for providing openings for Anglo Indians.

Science News a Century Ago

Translation of Cuvier's "Animal Kingdom"

Cuvier's "Animal Kingdom", which had been published in fifteen volumes by Edward Griffith and others, was reviewed at length in *The Times* of January 24, 1835 The whole of the Baron's "Règne Animal", said the reviewer, has been translated with a vast addition of supplementary matter, including a full description of all the species, calculated to render the work "not merely useful to the naturalist, as a book of pure science, but also interesting to the public at large, as a general zoological biography, and ornamental as containing original and well executed illustrations. . . The gentlemen who have been associated with Mr. Griffith in this arduous undertaking are Mr Edward Pidgeon, Colonel Charles Hamilton Smith, Mr John Edward Gray and Mr George Gray. Their competency and qualifications are sufficiently well known. . . Without entering into a more elaborate examination of the work, we may confidently characterise it as one which cannot fail to recommend itself to a very high rank in public estimation. It appears to have been executed with great care ; it evinces a large share of scientific talent and research in the editors ; and the plates, some of them from drawings by Landseer, are distinguished by great neatness and fidelity "

Of the authors of this work, Griffith (1790 1858) was an original member of the Zoological Society, John Edward Gray (1800-75) was a keeper at the British Museum and Col Smith (1776 1859) served in the Army in 1797–1820 After the appearance of the review, a correspondent wrote to *The Times* saying that Edward Pidgeon had died in poverty on October 14, 1834

Beaufoy's "Nautical and Hydraulic Experiments"

Col Mark Beaufoy (1764 1827), the son of a Quaker brewer, was a physicist and astronomer, but he will be remembered longest for his experiments on ship resistance, and as the founder in 1791 of the Society for the Improvement of Naval Architecture His experiments were made in Greenland Dock, Rotherhithe, during the period 1793–98 After his death, his son published at his own expense his "Nautical and Hydraulic Experiments with numerous Scientific Miscellanies", the book being printed at Beaufoy's private press in Lambeth In a review of the first volume of this work published in the *Athenæum* of January 24, 1835, many passages were quoted One of these said "For some years the calculations were made at Colonel Beaufoy's residence at Hackney Wick by himself, assisted by his wife, who contributed no inconsiderable share to the progress and success of the experiments , for favoured alike in person and in mind she was a good mathematician and astronomer familiar with all the details of the observatory, the calculation of eclipses etc she was never at a loss for leizure in the furtherance of her husband's pursuits "

In concluding his remarks, the reviewer said, "we have only to express our obligations to the publisher for the munificent gift he has laid on the altar of science By the time his work is completed, it will, it is reported, have cost together with the experiments it records, a sum of 60,000£, the value of thirty years assiduous labour not being counted in this estimate There is a munificence and devotion about this gift, which have, we believe, no parallel in the history of science"

Records of General Science

In January 1835, the first number appeared of a *Record of General Science*, a monthly journal edited by Dr R D. Thomson, lecturer in chemistry in the Blenheim Street Medical School, with the assistance of Prof Thomas Thomson, regius professor of chemistry in the University of Glasgow. It was published by John Taylor, 30 Upper Gower Street, London, bookseller and publisher to the University of London In the preface, after some remarks on the general history of periodicals, it was said "A few years have only elapsed since not less than six Scientific Journals were published in Great Britain ; these have now dwindled into two one of which is published monthly in London, and the other quarterly in Edinburgh". The number opened with an article by Prof Thomas Thomson "On Calico-Printing", illustrated with actual samples of material pasted in. Other articles dealt with respiration, the composition of the blood, vanadate of lead, transmission of heat through bodies, distillation of pit-coal and the magnetic intensity of the earth. Some of the articles were original contributions, while others were reprinted from the leading scientific journals published on the Continent

Societies and Academies

Paris

Academy of Sciences, December 10 (*C. R.*, 199, 1345–1463)*: Walter M. Elsasser: Forces and nuclear linkages. Joseph Laissus: The cementation of ferrous alloys by beryllium. Cementation by beryllium increases the superficial hardness of ferrous alloys, reduces the oxidation at high temperatures and increases the resistance to corrosion. Jean Cournot and Marcel Chaussain: Study of the influence of the mode of immersion of the test-pieces in corrosion experiments. Jacques Lefol: The hydrates of calcium aluminates, sulphoaluminate and chloroaluminate. Shinichi Kikuchi: Lithium cobaltinitrite. The preparation and properties of lithium cobaltinitrite, $\mathrm{Li_2Co(NO_2)_6\,8H_2O}$. Pierre Dubois: The hydrate and allotropic varieties of manganese sesquioxide. C. Zenghélis and Simon Evangelidès: The action of the silent discharge on nitric oxide (NO). The first phase of the reaction gives nitrogen (partly in the active form) and oxygen with some ozone. Subsequent recombination gives nitrogen peroxide and nitrogen pentoxide. Sébastien Sabetay: A rapid method for the determination of primary and secondary alcohols in essential oils. The method is based on acetylation with acetic anhydride using orthophosphoric acid as catalyst. Pierre Carré and David Libermann: The preparation of acid chlorides by means of thionyl chloride. Pyridine facilitates the reaction between thionyl chloride and certain organic acids and allows the preparation of some acid chlorides not formed in the absence of pyridine. Fernand Kayser: The two 1, 2-diphenyl-1-propanols and the two 1, 2-diphenyl-1-butanols, diastereoisomers. G. Darzens and André Lévy: The synthesis of a tertiarybutyl methyltetrahydronaphthalonic acid and of the corresponding butylmethylnaphthalene. Joseph Hoch: The preparation of the *N*-substituted imines of the fatty ketones. Arnaldo Peres de Carvalho: A γ-pyran of simple function, 2, 4, 4, 6-tetraphenylpyran. Marcel Frèrejacque: The mechanism of the autoxidation of uric acid. André Demay: The southern edge of the granite-gneiss massif of Ségala. Robert Laffitte: The stratigraphical limits of the Senonian in eastern Aurès (Algeria). G. Grenet and J. Coulomb: New forms of electromagnetic seismographs. V. Frolow: The propagation of the elementary components in the Yugoslav basin of the Danube. Pierre Dangeard: The structure and evolution of the nuclei with chromocentres. Henri Erhart: The influence of the pedological origin of seeds in the culture of cereals. René Moricard: Study of the modifications of the Golgi zone of the periovocytary cells in their relations with the development of the ovocyte and of the release of the processive maturation mitosis of ovulation and of the formation of the yellow body in the rabbit. A. Paillot: Cytological and organic modifications brought about in aphids by parasitic Hymenoptera. Maurice Fontaine: The relation between the ossification of the skeleton and of the state of the blood calcium in fish. Ph. Lasseur and M. A. Renaux: The agglutination of various bacteria by lemon juice. The facts cited suggest that the agglutination is caused by the hydrogen ions rather than by an antibody. Gaston Ramon, Rémy Richou and Miloutine Djourichitch: 'General' and 'local' antitoxic immunity. Experiments showing that the idea of a strictly local immunity is untenable. Jean Sabrazès and Jean Jacques Bounhiol: Experimental researches on post traumatic nephritis in the rabbit. Mlle Andrée Michaux: The amounts of chlorine and total phosphorus in the brain of guinea pigs, either normal, starved, attacked with chronic or acute scurvy. The amounts of magnesium in the striated muscles.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 10). Cl. Servais: On the geometry of the tetrahedron (11). Lucien Godeaux: (1) On Zeuthen-Segre's invariant of an algebraic surface. The author points out that a theorem concerning Zeuthen-Segre's invariant recently published by Campedelli was discovered by Godeaux in 1914 and published in 1920 in the journal of a local scientific society. (2) Remarks on the rational correspondences between two surfaces of genus one. P. Stroobant: Contribution to the study of the local system: galactic distribution of helium stars. The great majority of helium stars (type *B* stars) form a flattened agglomeration in confirmation of Charlier's views. The median surface of the system is not quite plane: its intersection with the plane of the galaxy is situated at 49° and 254°, while the maximum inclination is found at 175° and 320° of galactic longitude. E. Henriot: Angular momenta in electromagnetic theory (2). The electromagnetic theory of a refractive medium is considered and the angular momentum of a rotating electrified sphere is calculated. Pol Burniat: On the birational transformations of space having two isolated associated fundamental points (2). The transformations T_1 and T_2. O. Rozet: On the congruences of straight lines belonging to a linear complex. A. de Waele: Researches on the migrations of Cestodes (4). A study of *Coenurus cerebralis* in the living state and a comparison of its behaviour with that of *Cysticercus pisiformis*. Marcel Florkin: On the activity due to anhydrase of the interior medium of invertebrates. An examination of the blood, etc., of numerous invertebrates for the presence of the ferment, carbonic anhydrase, frequently with negative results. Z. M. Bacq and Henri Fredericq: An attempt to identify the chemical transmitter liberated in the nictitating membrane of the cat by sympathetic stimulus. The experiments show that natural *l*-adrenalin is the only substance which is able to reproduce with fidelity the phenomena shown by the chemical transmitter.

Geneva

Society of Physics and Natural History, October 18. Ch. Eug. Guye: The propagation of imbibition. F. Battelli, Don Zimmet and P. Gazel: The existence in muscle of a state opposing the stimulating action of a continuous current. There appears to exist in the muscle of the frog a state which is opposed to the action of the continuous current during its passage. This condition may be represented by a voltage of from one to three volts. If the muscle is submitted to a much higher voltage, its own potential is dominated by the potential imposed on it and it remains half contracted. The myogram shows a plateau.

November 1. M. Gysin: The presence of dipyre in the metamorphic formations of the Kundelungu of Haute-Lufira (Belgian Congo). The Haute-Lufira basin is constituted essentially by the lower Kundelungu arranged in folds parallel to the direction west-north-west. The anticlinals are marked out by faults and by zones of breccia with numerous outcrops of diabases. The sediments of the Kundelungu are strongly metamorphosed and contain dipyre crystals. This metamorphism appears to be due to the perimagmatic action of the diabases H. SAINI Note on the thermodynamics of the phenomena of imbibition and of amalgamation The problem of the propagation of a liquid by imbibition in a porous body, or by spreading out on a surface (mercury on gold) may be treated from a thermodynamical point of view by considering the free energy by the Helmholtz equation. If the phenomenon is endothermic (amalgamation of gold), it is found that the external work *E* against gravity and frictional forces should increase when the temperature *T* is raised If the phenomenon is exothermic, *E* may either increase or diminish when *T* is increased A MERCIER The relations between the distribution of the densities of the earth's crust and the values of gravity. Likening the continents to blocks of sial immersed in the sima and applying to them the laws of hydrostatic equilibrium, the anomalies observed in measurements *of the intensity of gravity* are approximately accounted for. The calculation is made for the region of the Alps and gives a value for the anomalies within the limit of the experimental results F BATTELLI, D ZIMMET and P. GAZEL. The hæmolysing action of tobacco smoke and of the smoke from other plants on the blood *in vitro*. R. WAVRE The representation of certain uniform functions W SCHOPFER Action of growth factors contained in urine The action on a micro-organism. The author shows that normal human urine contains a substance, differing from the usual substances and acting as a growth factor for a micro organism This substance is soluble in ethyl alcohol, dilute acetone, methyl alcohol and chloroform but insoluble in ether and benzene It is thermostable and is adsorbed by animal charcoal It differs from auxine and may arise from plant food

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**Continued from p. 79*

LENINGRAD

Academy of Sciences (*C R*, **3**, No 8–9). N KOSHLIAKOV. Some summation formulæ connected with the theory of numbers (2) P NOVIKOV: Some aggregate systems invariant in relation to the *A*-operation R. KUZMIN: Theory of the *L* (*s*) series of Dirichlet G GUREVITCH Trivectors in a space of seven dimensions P RASHEVSKIJ: Infinitesimal properties of geodesic lines in a two-dimensional space, in connexion with the measurement of an area I KURCHATOV, G SHCHEPKIN and A WIEBE. High-speed electrons liberated from fluorine after bombardment by neutrons V CHERDYNCEV Systematics of atomic nuclei N VEDENEEVA and S. CRUM-GRZHIMAILO: Spectro-polariscopic method of Umov as applied to the examination of minerals under the microscope B SHPAKOVSKIJ · Dispersion of ultra-sonic waves in a liquid. V. ALPATOV and O. NASTJUKOVA. Susceptibility of *Paramecium caudatum* to ultra-violet rays in relation to the colloidal properties of their protoplasm as it is affected by different physico-chemical methods Resistance of protoplasm to the destructive action of ultra-violet radiation can be increased by using electrolytes causing condensation of colloid, and reduced by using electrolytes which cause swelling V. KUDRIAVCEV A new apparatus for the determination of the vapour pressure of solutions by the dew-point method I. KROTOV: Methods of obtaining and investigating stannic and stannous sulphocyanides. I. NAZAROV: Splitting of di-tertiary alkylcarbinols by dehydration. The dehydration of tertiary butyl-tertiary amyl and tertiary butyl-tertiary hexylcarbinols. A BRODSKIJ, V. ALEXANDROVICH, M. SLUCKAJA and M SHELUDKO Concentration of heavy water Some improvements in the method suggested by Lewis and Macdonald (*J Chem Phys*, 1, 341, 1933) are described. A LOZOVOJ and M DJAKOVA. Chemical composition, properties and methods of treatment of the primary tars of the Tcheliabinsk lignites A PARSHIN (1). Fermentative splitting of adenylpyrophosphate in heart muscle (2) Metabolism of adenylpyrophosphate in isolated frog's heart A. STUDITSKIJ · Mechanism of the formation of regulating structures in the embryonic skeleton. Work executed on chicken embryos suggests that an organism in the embryonic state possesses mechanisms that are capable of complicated autonomous regulatory processes J KERKIS. Development of the sexual glands in interracial hybrids of *Drosophila pseudo-obscura* A ZAVARICKIJ Pseudoleucitic and epileucitic rocks D BELJANKIN Albite with small angular separation *of optical axes from the* Druzhnaya Gorka works N. ANNENKOVA: Paraonidæ of the Far Eastern seas of Russia Descriptions of three new species of worms of this family A SVETOVIDOV Growth of the Baikal whitefishes and graylings The rate of growth in Lake Baikal is considerably greater than elsewhere S CHERNOV Subspecies and the distribution of the lizard *Eremias arguta*, Pall I OLENEV · Pasture ticks (Ixodoidea) in the north-west of Russia A TARANEC Species of the genus *Hypomesus* in the basin of the Sea of Japan

PRAGUE

Czech Academy of Sciences and Arts, December 14 E VOTOČEK · A detailed study of the fucohexonic and rhodeohexonic acids and the configuration of their α-carbon E VOTOČEK and F. VALENTIN. Mercaptan condensation with 5-ketomethylpentonic acids New sulphur derivatives obtained by condensation of 5-ketomethylpentonic acids with different alkyl mercaptans This reaction represents a new transition from sugars to the furan series K CEJP New finds of Saprolegniales in Bohemia. V HOVORKA Separation of selenium from cadmium, lead, bismuth, antimony, molybdenum, tungsten and vanadium V HOVORKA. The loss of selenium in the reduction of selenites by hydrazine F KRATOCHVÍL. Beryl from Mochov near Poběžovice. F. PRANTL Carboniferous Bryozoa of Dobšina V. ZÁZVORKA and J SOUKUP · Cretaceous fossils of the Bělohrad country. V. POSPÍŠIL · Measurements of the influence of light on Brownian particles (dark ground illumination). V POSPÍŠIL: Mechanical theory of white day-seeing and night-seeing R RŮŽIČKA: Barrandien trilobites B BOUČEK Trilobites from the Czech Gotland (2) J. SLÁDEK and M. LIPSCHÜTZ. Polarographic effects of some amino-acids. This sensitive test for the sulphydryl group of peptides is obstructed by arginine, tryptophane, histidine, β-phenyl-α-alanine, and β-phenyl-β-alanine, contained in remedies for pernicious anæmia The β-phenyl-β-alanine, containing a labile hydrogen, gives a sensitive catalytic effect J. H. KŘEPELKA and J. KUBIS Study of ter- and quadrivalent manganese At −70° a purple solution of manganese trichloride in ether was prepared, which formed a black precipitate with benzene or carbon tetrachloride. Solid manganese tetrachloride cannot be prepared under these conditions. K. URBAN: The basic magma of the south slopes of Dumbier in the Low Tatras.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, January 20

British Museum (Natural History), at 3 and 4 30 —M A Phillips "Fossil Reptiles" *

Monday, January 21

King's College, London, at 5 30 —Prof G Temple "The Theory of the Radiation and Reception of Electro-Magnetic Waves by Aerials (succeeding lectures on January 28, February 4, 11, 18, 25, March 4 and 11) *

Royal Geographical Society, at 8 30 —Martin Lindsay "The British Trans Greenland Expedition of 1934"

Tuesday, January 22

British Institute of Philosophy, at 8 15 —(at University College, London, W C 1) —Sir Herbert Samuel "Philosophy, Religion and Present World Conditions" * (Ticket)

Wednesday, January 23

Geophysical Discussion, at 5 30 —(Joint meeting with the Geological Society in the rooms of the Geological Society, Burlington House, W 1) "The Hypothesis of Continental Drift", to be opened by Dr W B Wright

Royal Society of Arts, at 8 —C L Burdick "Humidity, Health and some New Inventions"

Thursday, January 24

Queen Mary College, at 5 —Prof W N Haworth "The Molecular Structure of Carbohydrates" *

Friday, January 25

King's College, London, at 3 15 —C. J Jadd "Babylonian Ideas of the Relations between Gods and Men" *

Royal Society of Arts, at 4 30 —C Ranganatha Rao Sahib "Recent Industrial Progress of Mysore"

Royal Institution, at 9 —Sir Richard Livingstone "Ancient Greece and Modern Civilization"

Official Publications Received

Great Britain and Ireland

British Industries Fair, 1935, Olympia and White City, London, February 18th to March 1st Organised by the Department of Overseas Trade Special Overseas advance edition Pp xvi+496+Ad 168+Ad xii (London Department of Overseas Trade) 1*s*

Catalogue of the Twenty fifth Annual Exhibition of Scientific Instruments and Apparatus held at the Imperial College of Science and Technology, South Kensington, London, S W 7, January 1st, 2nd and 3rd, 1935 Pp 192+lxii (London Physical Society)

The Registrar General's Statistical Review of England and Wales for the Year 1933 (New Annual Series, No 13) Tables, Part 1 Medical Pp iv+406 (London H M Stationery Office) 6*s* net

Forestry Commission Report on the Demand for Timber for Box and Packing-Case Manufacture in Great Britain. Pp 47 (London H M Stationery Office) 9*d* net

New Indicators and other Reagents Employed in Volumetric Analysis By Dr Alec Duncan Mitchell Pp 21 (London Institute of Chemistry)

Sheffield Public Libraries Interchange of Technical Publications Union List of Scientific, Technical and Commercial Periodicals in the Libraries of Members of the Group Interchange System (For Members only) Pp iii+83 (Sheffield)

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 14 The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 1 By Josephine Hardiman, Dr J Keane and Dr T J Nolan Pp 141–145 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 6*d*.

The University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1933–1934 Pp 24 (Sheffield)

Other Countries

Australian National Research Council David Lecture, 1933 Some Founders of Australian Geology Delivered at Science House, Sydney, November 17, 1933, by Prof Ernest W Skeats. Pp 24 (Sydney)

Malta Annual Report of the Working of the Museum Department during 1933–34 Pp xxv (Malta Government Printing Office)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol 36, Part 1 A Contribution to the Flora of the Aleutian Islands By Misao Tatewaki and Yoshio Kobayashi Pp 119+8 plates (Tokyo Maruzen Co , Ltd)

Journal of the Faculty of Science, Imperial University of Tokyo Section 2 Geology, Mineralogy, Geography, Seismology Vol 3, No 8 The Cambro Ordovician Formations and Faunas of South Chosen Palæontology, Part 1 Middle Ordovician Faunas By Teiichi Kobayashi Pp 329–519+44 plates 3 50 yen Vol 3, No 9 The Cambro Ordovician Formations and Faunas of South Chosen – Palæontology, Part 2 Lower Ordovician Faunas By Teiichi Kobayashi Pp 521–585+8 plates 1 00 yen (Tokyo Maruzen Co , Ltd)

Spisy vydávané Přírodovědeckou Fakultou, Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk) Čís 191 Dvě Kruhové Plochy čtvrtého Stupně (Sur deux surfaces cerclées biquadratiques) Napsal L Seifert Pp 24 Čís 192 Generis Trigonella L Revisio critica, Pars 2, 1 Scripsit G Širjaev Pp 15 Čís 193 Sur les arcs indépendants dans un continu localement connexe Par Eduard Čech Pp 10 Čís 194 Sur une équation fonctionnelle de la théorie des probabilités (seconde partie) Par B Hostinský Remarque sur un mémoire de M Hostinský, par J Potoček Pp 18 Čís 195 Anthropological Aspects of Blood Grouping By Prof V Suk Pp 9 Čís 196 Hetero Formiato-Soli Vápenaté (Hetero-Formiato Salze des Calciums), napsali J V Dubský a J Trtílek, Hetero Sloučeniny Kyseliny Glykolové (Hetero-Verbindungen der Glykolsäure), napsali J V Dubský a D Vinogradsová Komplexní Sloučeniny (MeX_2 2A) a (MeX_4)H2 2A (Komplex Verbindungen (MeX_2 2A) und (MeX_4)H2 2A), napsali J V Dubský a V Dostál Pp 23 (Brno A Píša)

Sborník vysoké Školy Zemědělské v Brne (Bulletin de l'Institut National Agronomique, Brno) Sign C28 Agronomická pomoc severního Irska (Kritický Náčrt) Napsal Prof Dr Vladimír Stein Pp 61 Sign D22 Kuklice (Tachinidæ) *Masarykova lesa* Napsal Dimitrij Jacentkovský Pp 38 (Brno A Píša)

Department of Agriculture, Mauritius Sugarcane Research Station Bulletin No 4 Some Properties of the Sugarcane Soils of Mauritius By N Craig Pp 35 (Port Louis Government Printer)

Dominion of Canada Seventeenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement, 1933-1934 Pp 149 (Ottawa)

Instituto Geográfico, Catastral y de Estadística Anuario del Observatorio Astronómico de Madrid para 1935 Pp 328 (Madrid)

U S Department of the Interior Office of Education Bulletin, 1934, No 6 Teacher Retirement Systems, Principal Provisions of State Systems By Ward W Keesecker Pp v+46 5 cents Bulletin, 1934, No 7 Bibliography of Research Studies in Education 1932–1933 Prepared by Ruth A Gray Pp xiv+349 25 cents Pamphlet No 5 (revised) State-Wide Trends in School Hygiene and Physical Education By Dr James Frederick Rogers Pp 15 5 cents Pamphlet No 51 Some Educational Activities for the Young Child in the Home By Rowna Hansen Pp 23 5 cents Pamphlet No 54 Teachers' Problems with Exceptional Children, 4 Deaf and Hard-of-Hearing Children By Beatrice McLeod Pp iv+29 5 cents Pamphlet No 56 Teachers' Problems with Exceptional Children, 6 Children of Lowered Vitality By Beatrice McLeod Pp iii+16 5 cents Vocational Education, Bulletin No 174, General Series No 5 Vocational Education and Changing Conditions Changing Economic and Social Conditions and their Effect upon Vocational Education Pp v+112 15 cents Vocational Education, Bulletin No 101, Agricultural Series, No 24 Analysis of the Management of a Corn Growing Enterprise, Managerial-Training Content of the Type Jobs of an Enterprise of Growing Corn for Grain Revised 1934 Pp v+18 5 cents (Washington, D C Government Printing Office)

U S Department of Agriculture Circular No 339 A Program of Waterfowl Restoration By J Clark Salyer II Pp 11 5 cents Technical Bulletin No 421 The External Anatomy of the Parlatoria Date Scale, *Parlatoria blanchardi* Targioni Tozzetti, with Studies of the Head Skeleton and Associated Parts By F S Stickney Pp 68+2 plates 10 cents. Technical Bulletin No 452 Experiments with Nitrogen Fertilizers on Cotton Soils By J J Skinner, R A Lineberry, J E Adams, C B Williams and H B Mann Pp 28 5 cents (Washington, D C Government Printing Office)

Smithsonian Miscellaneous Collections Vol 91, No 18 Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Monogenetic Trematodes from Marine Fishes By Emmett W Price (Publication 3286) Pp ii+3+1 plate Vol 92, No 10 Recent Discoveries of Cambrian Beds in the Northwestern United States By Charles Elmer Resser (Publication 3284) Pp ii+10 Vol 92, No 11 Phototropic Sensitivity in relation to Wave Length By Earl S Johnston (Publication 3285) Pp ii+17+2 plates Vol. 92, No 12 Remarkable Lightning Photographs By C G Abbot (Publication 3287) Pp ii+3+1 plate Vol. 92, No 13 The Standard Scale of Solar Radiation By C G Abbot and L B Aldrich (Publication 3288) Pp ii+3 (Washington, D C Smithsonian Institution)

The Imperial College of Tropical Agriculture Studies in West Indian Soils, 8 The Agricultural Soils of St Vincent By F Hardy, C K Robinson and G Rodrigues Pp 44 (Trinidad Government Printer) 2*s*

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Česká Akademie Věd a Umění (Académie Tchèque des Sciences et des Arts). Třída (Class) 2 Anthropologica. Zpráva o Výsledku Pátrání po Hrobě J A. Komenského a jeho Tělesných Pozůstatků (Rapport concernant le résultat des recherches entreprises pour retrouver la tombe de J Am Comenius et ses ossements). Napsali Prof Dr J Matiegka, Prof A. J P. van den Broek a Arch. Ing. Stan. Sochor. Pp. 60+6 plates. Anthropologie Středo afrických Pygmejů v Belgickém Kongu (Anthropology of the Central African Pygmies in the Belgian Congo) Napsali P Šebesta a V. Lebzelter Pp. 143+66 plates (Prague: Česká Akademie Věd a Umění.)

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Evolution and Human Origins

EVERY year brings to light evidence which implies a far greater ambiguity for man than that given to him in the book of Genesis The caves of Mount Carmel, for example, have quite recently been found to contain deposits, fully sixty feet in thickness and laden with fossil bones of man and beast, to say nothing of a succession of stone implements The ancient Palestinians represent a breed of the extinct Neanderthal species , the stone tools are of the kind used in Europe long before the onset of the last glaciation Even more revolutionary are the contributions which Africa is now making to the solution of the problem of man's origin East Africa is proving to be particularly rich in deposits laid down during Post-Pliocene times In the oldest of these deposits, Dr L S B Leakey has discovered crudely worked hand-axes , on the overlying beds he has traced a gradual refinement of this type of tool He has also found fragments of the East African tool-makers Yet the oldest of these deposits were laid down at least half a million of years ago So it has been with every part of the Old World China, Java, Australia, Italy, Spain, France, Germany, Belgium and England, each has contributed its quota of evidence

Why is it that all the anthropologists who have had to interpret the evidence of these discoveries, have presumed that the theory of evolution is true, and that the Mosaic tradition is wrong ? The first reason is that the Biblical background of time is too restricted , the evidence now at the disposal of anthropologists requires a time-scale which runs into hundreds of thousands of years The second reason for the rejection of special creation as a manner of origin, is man's mode of development He arises, as do all other vertebrates, from a fertilised egg his development within the womb is almost identical to that pursued by the great anthropoids Piltdown man, Heidelberg man, *Pithecanthropus* (Java man), *Sinanthropus* (Peking man), and Rhodesian man, have never been regarded by anthropologists as special creations they have presumed that such fossil specimens were twigs which had fallen from the evolving tree of humanity They have made many attempts—most of them purely tentative—to reconstruct man's evolutionary tree

Anthropologists are prepared for criticism directed against the form they have given to their trees of human evolution, but they did not anticipate that anyone would attempt to sweep out of existence their evidence and the superstructure they have built on it This, however, is what *has* happened Sir Ambrose Fleming, in his presidential address* on January 14 to the Victoria Institute, asserted ' that this sedulously propagated hypothesis of man's age-long evolution by Darwinian Natural Selection is the product rather of the imagination than based on indisputable evidence . The cardinal error is that it substitutes as the ultimate source of all things an impersonal self-acting or automatic process of improvement, in place of the Will and Power of a personal, Self-conscious Creator and Father of Mankind *Adherence to the doctrine of evolution is entirely inconsistent with belief in the fundamental doctrines of Christianity* " We have italicised the last sentence of this quotation because it seems to us that Sir Ambrose has loaded his dice very heavily against those who believe in evolution

How, then, does Sir Ambrose deal with the evidence on which the anthropologists have built so much ? First he sweeps away their time-table , he describes it as an "unjustified assumption" and as a "guess" Yet it is the kind of "guess" we all make daily when we seek to assess the age of the man, woman or child we may pass on the street We have no difficulty in distinguishing between the ages of a boy of ten and a man of fifty Geologists and anthropologists will certainly be astonished by Sir Ambrose's assertion that the history of *Homo sapiens* can be fitted into the calendar of Biblical dates He prefers the chronology of William Hales, who assigned the creation of Adam to the year 5411 B C to that of Archbishop Usher, who gives 4004 B C as the eventful date He regards "the palæontological or fossil evidence" as being "painfully small" He makes short work of the "discoveries" on which students of man's origin rely so much "The few scattered remains represented by the Java, Heidelberg, Piltdown and Pekin 'man', as far as they are not truly animal may rather be regarded as biological abnormalities or cases of decadence rather than stages in an upward development "

Having dismissed these fossil remains from his consideration, Sir Ambrose is left with only two early forms of humanity to be fitted into the inspired scheme of special Creation—namely, Neanderthal man and Cro-magnon man The latter he hails as real sons of Adam , he recognises in them the moral and spiritual attributes of true man Seeing that the Cro-magnons appeared in Europe long before the ice-age had ended, and that Sir Ambrose admits that "there is evidence not altogether negligible that a last glacial epoch may have ended not much more than seven to ten thousand years ago", it is difficult to see how they could have made their way into Europe from the Garden of Eden if the event of man's creation di occur at the date postulated by him, namely, 5411 B C He apparently forgets, also, that the evidence from Egypt indicates that men were not only living in the valley of the Nile at that time, but were already sowing and reaping, spinning and weaving and burying their dead in the expectation of a life hereafter, for how otherwise can we explain the 'goods' which are found in the graves of the early Egyptians

Very different is the position which Sir Ambrose assigns to Neanderthal men, who were in existence before the onset of the last glacial epoch. He refuses to regard them as true men , he maintain that they were destitute of "the mental and spiritual power" of true men In this he is not just, for one of the most representative specimens of this species of extinct humanity, namely, the man of La Chapelle, was buried with weapons and food—which we may justly interpret as evidence of a belief on the part of his people that the dead had a life when the earthly one was over

In connexion with the origin and nature of Neanderthal man, Sir Ambrose puts forward a "view" which raises a very interesting question. Is it permissible to alter in even the slightest detail the inspired word of the Bible ? To do so is to bring the "inspired word" down to the level of a scientific hypothesis, for it is of the nature of a hypothesis that it may be altered to meet fresh facts as they arise "There is another view," he said, "which may be put forward very tentatively and that is that between the anthropoid apes and true man with his psychical and spiritual as well as bodily structure, there *may* have been some species of hominoids created with more than ape intelligence, but not 'man' in the sense of the word used in the Bible " This view is put forward as an alternative to the "view" that Neanderthal man is a degenerate form of true man Sir Ambrose's critics may fairly complain that he has gone beyond any justification obtainable from the Mosaic record They may also complain that he cites only one version of the creation of man from the book of Genesis—namely, Genesis, i 26. "Let us make man in our image, after our likeness." The fact that the book of Genesis is a composite work, and that it includes two versions of creation derived from separate sources has, of course, long been recognised by Biblical scholars. More instructive than the above version is the different description of the creative act given in Genesis, ii 7, "and the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul". We should have expected, too, mention of the manner in which Eve came into being, and how the prediluvial population of the world had arisen from a single pair.

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* Modern Anthropology *versus* Biblical Statements on Human Origin By Sir Ambrose Fleming Pp 25 (London Victoria Institute, 1935) 1s.

We are sure that Sir Ambrose Fleming would *not wilfully misrepresent the case of his opponents; yet there is no doubt he has been unfair to the* Bishop of Birmingham. "There are," said Sir Ambrose in his lecture, "no sufficient reasons for declaring the evolutionary origin of the human race a definitely certain fact. Certainly none for assuring a general congregation in Westminster Abbey, as did Bishop Barnes, on Sunday, Sept 25, 1927, that 'To-day there is among competent men of science unanimous agreement that man has been evolved from an ape-like stock'." In so far as anthropologists were unanimous in 1927 as they are to-day in regarding man as a product of evolution and not of special creation, we hold that the statement made by the Bishop of Birmingham was amply justified. We rejoice, too, to note that the new dean of St Paul's, Dr Matthews[1], supports the evolutionary doctrine of man's origin and in opposition to Sir Ambrose Fleming sees no incompatibility between the doctrine of evolution and the precepts of Christianity.

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[1] *Daily Telegraph*, Jan 18, 1935. "Evolution and the Human Race."

Malaria in Ceylon

THERE is unfortunately no doubt about the serious nature of the epidemic of malaria in Ceylon. The telegrams in the Press report that in the affected provinces no less than 3,435 deaths from malaria and fever occurred during the month of December, compared with a monthly average of 531 for the first nine months of the year. It is admitted, however, that these figures are not final. It has been reported that there have been more than half-a-million cases of malaria, and if the death-rate was 5 per cent, that would give us something like 25,000 deaths.

The first need in an outbreak like this is medicine and food, and the Government of Ceylon has been in the happy position of being able to draw supplies of quinine from both India and Java. There is, however, another greatly complicating factor, and that is famine. The drought which has prevailed—and is generally regarded as the cause of the epidemic—has led to a serious failure of crops, and, even if the rain had not failed, the people themselves have been so weakened by disease that they have not been able to cultivate their fields. We may therefore expect that, in a people weakened by want of food and by malaria, this epidemic will be followed by a serious outbreak of dysentery and a rise in the general death-rate from all causes.

The epidemic itself has not been caused as epidemics frequently are, by the introduction of non-immune people into a malarial territory. The outbreak is in a part of Ceylon which is normally healthy. The new factor has in all probability been an increase in the number of mosquitoes. Among any healthy population in the tropics there is always a certain number of people carrying the infection; and when, as appears to be the case in Ceylon, there is a large increase in the number of mosquitoes, it is easy for the mosquito to acquire infection and to start a serious epidemic. Once a mosquito is infected it remains infected for life; and, further, as this epidemic is occurring among people who are not accustomed to malaria, the epidemic is so much the worse.

Valuable entomological work has been done in Ceylon by the Government Entomologist, but in view of this great epidemic there must be a full reinvestigation. Until we get that, everything is necessarily speculative.

One hypothesis is that, owing to the drought, rivers are not flowing so rapidly as they usually do, pools remain in the rocky and sandy beds, and *A. culicifacies* is breeding profusely. That may be so, but we must not forget that there are some thirty species of *Anopheles* in Ceylon and that they include species of the *A. minimus* group and *A. maculatus*, which in other countries are important carriers of malaria. A grave mistake might be made if a full investigation is not made into what mosquito, or mosquitoes, have been the active agents in producing this epidemic in the various parts of Ceylon to which the epidemic has spread.

Obviously the people of Ceylon were not

prepared for a great epidemic , it will be necessary for them to take stock of their position The ancient cities buried in the jungle are a reminder that malaria is no new disease in Ceylon Governing authorities should ask themselves Have they used the knowledge that Ross gave them to the fullest possible extent, or have they made no special effort, thinking that nothing could be done ?

Clearly some sort of inquiry will inevitably be held, but what is required is not so much a search for a scape-goat or an inquest, as a constructive scheme for the future, built on a sure scientific foundation

Reviews

Newton's *Principia*

Sir Isaac Newton's Mathematical Principles of Natural Philosophy and his System of the World Translated into English by Andrew Motte in 1729 The translations revised, and supplied with an Historical and Explanatory Appendix by Prof Florian Cajori Pp xxxv + 680 (Cambridge At the University Press, 1934) 35s net

ANDREW MOTTE'S translation of the "Principia" is not so well known as it deserves to be It was supplied to his brother, the publisher, soon after Newton's death One might expect it then to be no more than a publisher's hack work, of which we have so many dismal examples But Motte appears to have understood the "Principia", and his language does not date noticeably, and never falls below a good level The present work is really a republication of Motte, with some improvements, and—it is regrettable to add—one most serious omission

Prof Cajori died in 1930, so that the book has been seen through the press by Prof R T Crawford, of the University of California, Berkeley But the changes in Motte's text, the notes, and the work generally, is credited to Cajori. The notes seem to be complete, but might perhaps have been put into a compacter form, had the author lived In their present shape, they give a certain number of references, but scarcely advance any of the subjects Along with the "Principia" is a translation of the lectures given at Cambridge and called "The System of the World", which Prof Cajori, apparently with good reason, also puts down to Motte It is quite worth presenting, for, though it is not so complete as the "Principia", it is less guarded and less austere

One distinct improvement upon Motte is found in printing the diagrams among the text, as they were in the various editions of the "Principia". Motte, no doubt in the interest of economy, collected them together and put them into folders Most of Prof Cajori's changes are modernisations. One requires to think a little, now, before one remembers the meaning of "sesquiplicate ratio" and the like But nothing can be done to improve the awkward, old analysis, nor is Prof Cajori quite consistent Thus [*quantitas*] *genita*, retained by Cajori as "a *genitum*", is simply what we now call a function, and "square or cube sides" for "*latera quadrata, latera cubica*" is retained where the modern equivalent would be square root or cube root Nor does he always correct Motte's mistranslations In Newton's celebrated experiment upon apparent and absolute rotation, *situla* means a bucket, whereas Motte translates it a vessel, and Cajori retains this It is a pity that the work did not fall into the hands of a stricter scholar

But these are minor matters The risk of a translation is that it may be more obscure than the original The "Principia ' was considered a hard book by people of the time, and Newton deliberately refused to make it more popular In many places he wrote with the extremest compression An example is the Second Definition, which runs "*Quantitas motus est mensura ejusdem orta ex velocitate et quantitate materiae conjunctim*" This figures here—scarcely changed from Motte—as "*The quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly*" This seems to me more obscure than the Latin original The comma and the 'the's have spoiled it As one pores over the original words, one reflects that Newton was a geometer, who said, when he pleased, everything at once, so that all parts of his statement must be taken together Newton picked his words, and in many places one will prefer to see what Newton himself wrote, not what Motte or Cajori made of it

Yet the book is a pleasant book, and to the large but not universal class who read English more easily than Latin, it presents distinct advantages in finding one's way about It is doubtful whether it will be read by so-called 'students', which may be taken to mean young men in a hurry The great defect of the book is that it has not an index. A fairly good index was added to the second edition, and Motte gave one too, but Cajori has suppressed it There are multitudes of details dealt with here, some of them most unexpected, such as remarks upon the finite velocity of light, and significant both for what Newton said, and what he did not say In fact, the "Principia" must be easily the most interesting scientific book ever written It is nearer to our own time than Euclid's 'Elements" Besides, those that have read Sir Thomas Heath's translation and notes on the original text know that the versions that have reached us are very much doctored

The original "Elements" were not at all a school book, but were of philosophical intention , and most of the questions treated by Euclid are now uninteresting The "Principia", on the other hand, besides being the bible of the modern scientific method which has now overrun the whole world, discusses a host of questions that are still alive A short reminder of its contents proves this It begins with a brief philosophical discussion Newton is always briefest when he has thought most and has made up his mind Then the laws of motion The principles of dynamics, including some significant forecasts Absolute and relative rest The interpretation of Kepler's laws The geometry of conics The calculus The law of gravitation Detailed inferences as to the disturbances of the sun and moon upon the earth—one of the propositions has as many as twenty-two corollaries, many of them of lasting importance Resistance of bodies The form of the "body of least resistance" Many detailed and admirable descriptions of experiments The velocity of sound Some important reflections upon light Applications of the law of gravitation to the heavens. The proof that it is gravity which retains the moon in its orbit The precession of the equinoxes. The tides The lunar theory, giving a very adequate calculation of the variation and of the motion of the nodes, and a less adequate calculation of the change of excentricity and the motion of the apses The motions of comets, showing that they obey exactly the law of gravitation Numerous personal references Numerous general scholia, containing remarks at large upon all kinds of questions, such as the relations of the Deity to human affairs.

This is a brief and imperfect list, but it will serve its purpose Surely never was such a torrent of thought produced by eighteen months' work The main points may have been ready before, but many of the details must have been added as the book was written No one really knows what may be in the "Principia", and one is likely to forget one part while one puzzles over another, deciding whether Newton was right—for there are inevitably a good many errors—and picking out the gems of profound thinking from the old-fashioned analysis and mode of expression Not to give an index to a book like this largely defeats the purpose of the volume. The original index ought to have been enormously extended in place of suppressing it altogether. One would willingly have sacrificed the fifty pages of notes for the purpose

Motte did not try his hand at Halley's verses In the second edition, Bentley touched them up, improving their latinity, I suppose, but I prefer them as Halley left them They are worthy of the book, and of the part Halley played in producing it The eloquent passages seem to me to have been meant Here we have a translation by "Leon J Richardson, Professor of Latin in the University of California" It is a poor affair and gives no evidence that the writer knew what he was talking about "*Cur remeant nodi curque auges progrediuntur*" was left untouched by Bentley, but does not figure here—the evil-minded may suspect that Prof Richardson did not know that the apses moved forwards and the nodes backwards, nor thought it remarkable when it was mentioned No ancient that wrote on astronomy would have missed the point There is also a photograph of the portrait in Magdalene College, Cambridge, which Edleston published , and a reproduction of the title page of the first edition, somewhat reduced laterally to make it fit

R A S

Tea and Tea Production

The Culture and Marketing of Tea By Dr C R Harler Pp xii + 389 + 8 plates (London Oxford University Press, 1933) 12*s* 6*d* net

DR HARLER informs us that "the first authentic account of tea was written by Lo-yu who lived about A D 780 He describes the preparation of the leaf, which, he says, must only be picked during certain moons and not when it is raining or the sky cloudy" that "China, the classic tea country, gave both the word 'tea' and the beverage to the world" , and that "the words *te*, *chia* and *cha* denote tea in various Chinese dialects and in one or other of these forms has been transposed into most other languages" The first pound of tea imported into England is attributed to Lord Arlington in the year of the Great Plague of London (1665–66) It cost his lordship sixty shillings and was brought by him from Holland His residence, Arlington House (demolished in 1703), at that time was on the site where Buckingham Palace now stands (*see* "Old and New London", by Edward Walford, vol 4, p 62)

"Tea was known in Europe in the middle of the sixteenth century and the Dutch began importing it early in the seventeenth century. In Queen Anne's reign, tea drinking in England became fashionable and rapidly spread In 1703 the import into England was 100,000 lbs About a century later in 1805 it was 7½ million lbs Tea was still then a 'China drink' and remained so for many years." Now, out of a world's production of about 900,000,000 lb the British Isles takes approximately half the amount Dr Harler (p 373) furnishes the interesting facts that "the annual tea consumption in Great Britain is about 9 lbs per head" and that "in Russia in normal times, the annual consumption per head in the towns is 3·7 lbs, in the villages 0 37 lb, in Siberia 1 8 lb and in Russian Central Asia and Turkestan 2 7 lbs"

A correspondent some time ago in the *Tea and Coffee Trade Journal* gave the British Isles as the largest consumer in Europe—9 87 lb per annum · at the same time quoting the figures for Germany, 0 20, Italy 0 009, France 0 09, and Holland 3 17 lb per head respectively

London is the most important market for tea, and it is practically the centre of the trade for all countries and, as with spices, so with tea the market is concentrated in Mincing Lane and immediate neighbourhood, where the stocks at any one time may lie between 100 or 200 million lb and upwards

At the present time it would seem that the tea trade, like certain other great agricultural industries, is suffering from over-production, and according to the work under review (p 382) "drastic steps were taken at the end of 1932 to reduce stocks", and an agreement was made between India, Ceylon and the Netherlands East Indies, which was calculated to put about 120 million lb of tea less on the market in 1933 The scheme is subject to modification from time to time for five years, and although the early effect on prices, it is considered, has been highly beneficial, the ultimate advantages would appear to be somewhat indefinite

In the preface, the author states that his book does not pretend to be an exhaustive treatise on tea, but records his experience during the fourteen years he had been connected with the tea industry in north-east India as a scientific worker in the service of the Indian Tea Association Nevertheless, the volume produced is serviceable and comprehensive On page 73 he records the facts that "when tea cultivation was introduced first into Java in 1825 and India in 1835, Chinese methods of preparation were employed The industry developed steadily in Assam and Northern Bengal and in these areas, collectively referred to with regard to tea as north-east India, hand methods were gradually replaced by machinery from 1870 onwards and distinct modifications in the Chinese process were introduced In Java and Ceylon the industry developed at a later date, and these countries have taken the methods of north-east India and adapted them to local conditions" Four chapters are devoted to north-east India, dealing with general aspects of the country, geology, climate, soils, etc, the development, culture and manufacture of tea, in the third part of the work. The whole subject is dealt with in four parts, the first giving a general description of the tea plant and tea production, the second on chemistry and pharmacology of tea, the third part—in addition to the four chapters—as above referred to, also includes chapters on tea in China and Japan, Formosa, Ceylon, Java and North and South India, and the fourth part, in two chapters, deals with the "British Tea Trade", the marketing, production and consumption of tea

There are eight good illustrations, and two maps—of north-east India, showing tea areas, and south-east Asia, including the tea districts of China and natural tea tracts

The useful modern works on tea are not numerous, and the author is to be congratulated on making an excellent addition to our store of knowledge on the subject J H H.

Science and Social Welfare

L'Économie humaine par la médecine sociale Par René Sand Pp vii+305 (Paris Les Éditions Rieder, 1934) 30 francs

IT would be difficult to over-praise this book, which ought to be promptly translated into the chief European languages. Nothing similar has yet been attempted, although, when done, one wonders why it has been left to Dr René Sand The reason no doubt is that he is a Frenchman, with the French gift for clear arrangement and for making the abstract attractive Within three hundred pages one has a perfect conspectus of what science, especially medical science, has done to raise the general health, and promote social welfare, within the last few decades Though the general conclusions are amazingly encouraging, there is no attempt to gloss over the black spots, which are described here and there with a poignant pen

The most useful is the earlier part of the book, in which is given a comparison which could scarcely be found elsewhere, of vital statistics with other conditions of life, sex, race, economic position and so on Two or three general conclusions stand out in startling uniformity One is, the universal agreement of better health with better economic conditions Another is the similarity of the movement in all countries, just in proportion to the degree in which they have organised their social services. The third, and most hopeful, is the steady increase in improvement in all the years under review—except, of course, in certain obvious cases due to the War. Even the two recent years, which the author refers to as 'la crise', have not seriously abated the upward trend.

The knowledge shown of all the agencies at work, in what is usefully defined as 'la médecine sociale', is colossal. Every author, every society and every movement in the civilised world comes under review and yet there is no crowding and no tedium. The book is as easy and attractive to read as it is comprehensive and convincing. It is, of course, what would in a loose sense be called 'socialistic', and towards the end the author adopts the 'ought' tone rather more frequently than is quite consistent with a strictly scientific point of view. One feels here and there that something might be said in defence of more individual liberty and in qualification of the all-embracing paternal rôle which is assigned to the State and the community. But this is no place to discuss a very large philosophic question. Let us be thankful for the indisputable evidence of vital progress which the book affords, and hopeful for the continued benefits which science, wholeheartedly applied, holds forth in the future.

F. S. MARVIN.

Short Notices

Collected Papers of Charles Sanders Peirce. Edited by Charles Hartshorne and Paul Weiss. Vol. 3: *Exact Logic.* Pp. xiv+433. 24s. 6d. net. Vol. 4: *The Simplest Mathematics.* Pp. x+601. 25s. net. Vol. 5: *Pragmatism and Pragmaticism.* Pp. xii+455. 21s. net. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1933–1934.)

IT is difficult to deal adequately, even in a longer notice, with the extraordinary diversity of topics touched upon or discussed in these volumes. They fully support the editor's opinion that Peirce was "one of the most original and prolific logicians of the nineteenth century". Vol. 3 contains mainly papers on the algebra of logic and the logic of relatives, in which several improvements on Boole's method are suggested. There is also an excellent paper on the logic of number, and an essay on "The Regenerated Logic" which contains some pertinent remarks about the relations between mathematics, logic and philosophy. For example, Peirce draws a distinction between logic and mathematics, to which he denies the character of a positive science in so far as it does not deal with any aspect of reality, while philosophy does deal with reality, if not through special observations, yet by the study of the universal phenomena of experience.

Vol. 4 deals with the various aspects of the logic of quantity and with the use and interpretation of existential graphs as aids to logical theory. The remarkable chapter on the "Simplest Mathematics" begins with an interesting discussion about the essence of mathematics and its main divisions. There Peirce defines mathematics as "the study of what is true of hypothetical states of things" (p. 193).

Vol. 5 is perhaps the most important one for the history of thought, in view of the fact that it contains practically everything of importance which Peirce is known to have written concerning his famous theory of "how to make ideas clear". Half this volume is composed of hitherto unpublished papers. Some of his most striking conclusions are that logic is subsidiary to ethics and æsthetics; that pragmatism is a method of logic rather than a principle of metaphysics, and that pragmatism entails scholastic realism which, in its final pragmatic interpretation, means the ascription of purposive habits to Nature. These main theses are supported by a wealth of arguments covering the various aspects of the theory of knowledge. A conscientious study of this volume would no doubt help the reader to discover a certain interpretation of pragmatism which is not generally current among the followers of this doctrine.

Anatomy of Animal Types for Students of Zoology. By Prof. E. A. Briggs. Pp. xix+250. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1934.) 10s. 6d. net.

PRACTICAL courses dealing with animals are a strong feature in the teaching of elementary zoology such as is required for medical students. Many guides, dealing with suitable local animal types, have been published. Most of these are dry-as-dust 'anatomies', the use of which is preceded by lectures. These in the writer's student days dealt mainly with the forms of the different organs in a number of dead corpses, with notes on their evolution deduced from the same, whereas to-day the centre is the living animal in relation to its mode of life.

Here for Australia, especially Sydney, is a little textbook for the practical work. The animals chosen are Australian species, or cosmopolitan forms that have been introduced. Each is described as the student should examine it, proceeding from external features to internal anatomy, and suggestions are made as to drawings, dissections, microscopical examinations and so on. There are happily no illustrations in the book to distract the student's attention from the animal, the dissection of which is mainly of use in teaching observation and interpretation.

The author's views are sound; he wishes to approach his animal from two points, "firstly, that of structure, and, secondly, that of function", but we fear he has largely forgotten the latter—and such simple examinations of function as might be possible—in his maze of anatomical fact. His book is, nevertheless, an advance on most similar textbooks, but he should recast it on thoroughly modern lines so that Australian students may be freed from out-of-date manuals on practical zoology that are a curse not only to them but also render ineffective the best efforts of their teachers.

The Riddle of the Universe To-day. By Joseph McCabe. Pp. ix+250. (London: Watts and Co., 1934.) 5s. net.

THE author points out quite rightly that, in spite of some popular pronouncements about the idealistic or spiritual character of present day science, the materialistic interpretation of knowledge continues to flourish as it did in Victorian days. A rapid survey of recent advances in every branch of science helps him to illustrate his contention, and to conclude that "neither physics nor mathematics could ever discover anything that would disturb the materialist. You might as well hope to discover a spiritual world by the use of the spectroscope" (p. 225). This is obvious if we restrict our knowledge artificially to the immediate data of the external world. But this is not the sense in which should be interpreted the assertion that materialism has lost the predominant position it held some years ago. This assertion simply means that the recent advances in the various sciences, coupled with the analysis of their possible interpretations, reveal in the world of inanimate things as well as in the mental and social life of the individual, a purpose, an order, a manifestation of causality which cannot be exclusively and ultimately accounted for in terms of matter. However important, necessary and immediate matter is for the ordering of our knowledge, we are bound to admit its allegiance to a higher principle, that is, to spirit, with all its implications.

T. G.

Raumchemie der festen Stoffe. Von Wilhelm Biltz. Pp. x+338. (Leipzig: Leopold Voss, 1934.) 22.50 gold marks.

PROF. BILTZ is well known for his long series of researches on the physical chemistry of solids. In this book, which brings together much previously published material and also many determinations which have not otherwise been published, he attempts a systematic survey of the whole field, the primary object being the determination of the absolute volumes of the ions in crystals. The first part of the book consists of a number of detailed tables, in which the rich experimental material is collected in an easily appreciated form, and in the second part a detailed discussion of this quantitative material is presented.

Prof. Biltz has had the assistance of other specialists, and the resulting volume is one which possesses an unusual interest not only for chemists but also for physicists who are concerned with crystals. Full references to the literature are given, and the collection of numerical data in the tables would in itself make the book very useful. When this is accompanied by a systematic and detailed attempt towards the interpretation of the results, the value of the book is considerably enhanced. The relations with valency are particularly emphasised, and in this direction the monograph will appeal to both chemists and physicists. The book is one which can be recommended as both rich in information and also in theoretical discussions which reach into many fields.

Hydrology and Ground Water: a Practical Text-Book for the use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey. Pp. viii+159. (London: The Technical Press, Ltd., 1934.) 10s. 6d.

THIS is the re-issue of a textbook which was first published about eight years ago, and is based on a series of articles which originally appeared in the columns of *Engineering*. It is a conveniently sized manual affording a good general survey of the subject in twelve chapters, which deal in turn with sources of water supply, measurement and variations of rainfall, evaporation, soil permeability, ground water and springs, run-off or surface yield, storage, floods and wells.

Within its limits, the book provides quite a serviceable guide to those who have to deal with questions of water supply and control, but, as it professes to cater for the needs of "engineers who are engaged in Water Works, Irrigation, and Drainage schemes", it must be said that there are several respects in which the information supplied on those subjects is somewhat meagre. Apart from floods, for example, land drainage receives no very conspicuous treatment. If one were disposed to be captious, exception might be taken to the opening statement that "the source of all water . . . is rain", ignoring the existence of snow, hail and dew as distinct forms of atmospheric moisture. It is true that snow and hail are mentioned on the succeeding page, but only casually and without explanatory comment. The formation of dew is left undescribed, and there is no mention of dewponds as a possible (though limited) source of supply. The section on wells is perhaps the best, as it is the most extensive, constituting 40 per cent of the volume, with examples of calculation of yield, which assume a knowledge of the calculus on the part of the reader. The author illustrates very largely from Indian practice.

B. C.

Indian Psychology: Perception. By Prof. Jadunath Sinha. Pp. xvi+384. (London: Kegan Paul and Co., Ltd., 1934.) 15s. net.

THIS very interesting work outlines and discusses the most important topics of Indian psychology with special reference to doctrines of perception. As there is scarcely any experimental psychology in India, introspection and observation are the basic methods displayed. This fact, coupled with the synthetic and metaphysical characteristics of the Indian mind, points to the dependence of psychological doctrines on the fundamental currents of Indian philosophy. Yet, observations and doctrines on specifically psychological questions are numerous and original enough to justify its special treatment. Prof. Sinha thus discusses the various aspects of Indian psychology in their proper setting. Subtle analyses of mental processes are revealed both in normal and in abnormal psychology. The three chapters on illusions, dreams and abnormal perception are very striking in this respect. Philosophers will welcome Prof. Sinha's book as an important addition to their library.

A Condensation Theory of Meteoric Matter and its Cosmological Significance

By PROF. BERTIL LINDBLAD, Director of Stockholm Observatory

IN connexion with a theory on the constitution and development of stellar systems, I have recently directed attention[1] to the significance of the great difference in temperature between the interstellar gas and solid interstellar particles as an explanation of the origin and growth of meteoric particles. If we assume with Sir Arthur Eddington[2] a temperature of 10,000° for the interstellar gas and, on account of the low energy density, a temperature of about 3° for solid particles, the latter must be assumed to grow by the condensation of sublimed matter on their surface. This conclusion is in accordance with the conclusions drawn by I. Langmuir[3] concerning the nature of the process of condensation of metallic vapours on solids. In the present case, the energy of impact of atoms on the surface of the particle will be rapidly radiated into space, or perhaps to some small extent transformed into sub-atomic energy, so that the particle remains cold. We assume that the interstellar gas actually contains all the elements in about the proportions formed in the earth's crust and in the sun, and that the apparent predominance of calcium and sodium is due to the easy accessibility of very strong spectral lines due to these elements, namely, the *H* and *K* lines and the *D* line. For atomic weight 50, the temperature 10,000° gives a mean speed of the atoms of 2 km. per sec., and assuming a density of 5 for the solid particles formed, we readily obtain the formula

$$m = 10^{36}(\rho t)^3,$$

for the mass m of the particle in grams after the time t since the formation of an 'infinitesimal' nucleus expressed in years. For the density ρ of the interstellar gas we may adopt Gerasimovic and Struve's[4] value, 10^{-26} gm. per cm.^{3} In the time $t = 10^9$ years we then get particles of the size 10^{-15} gm., which is the order of magnitude of the particles in the obscuring clouds of the Milky Way according to the recent results derived by C. Schalén[5] from an investigation of the absorption effects in the photographic spectrum of early type stars in various Milky Way regions and an application of Mie's theory of the absorption of light by colloidal particles. It is remarkable that the mean density derived by Schalén from the number of particles per cubic centimetre agrees well with Gerasimovic and Struve's value for the interstellar gas. We may further remark here that the time of 10^9 years agrees with the average order of magnitude of the age of meteorites derived by an analysis of radioactive material.

The result obtained for the small interstellar particles encourages us to apply our formula to the formation of meteoric material in somewhat denser regions in space as well. Before leaving the small obscuring particles, we may add, however, that these particles will adopt motions corresponding to the mean motion of the interstellar gas, which we know follows closely the rotation of the stellar stratum around the centre of the stellar system situated in the direction of the constellation Sagittarius. (The distance to the centre is estimated to be 10,000 parsecs, or about 30,000 light-years. The period of rotation at the position of the sun in the system is nearly 2×10^8 years.) The consequence will be that the particles will get only small velocities relative to the circular motions, and will show a strong galactic concentration, presumably much stronger than the galactic concentration of the interstellar gas itself. This result is quite in accordance with the empirical data regarding the region of obscuration in our stellar system.

For an accumulation of material through gravitational forces to be possible in the case of an angular velocity of rotation corresponding to the period of revolution just mentioned, we should have a minimum density of about 10^{-22} gm. per cm.^{3} In 10^9 years we get with such a density particles of 10^{-3} gm., which seems to be the minimum mass of observed meteors. We assume here throughout a temperature of about 10,000° for the gas and a temperature near zero (absolute) in the case of the particles. Even rather large changes in the temperature of the gas, however, will not affect the order of magnitude of m.

If we assume the sun and the planetary system to have evolved from a gaseous nebula, stretching at a certain time over the orbits of Neptune and Pluto with a reasonable concentration towards the central nucleus, we might estimate the density in the outer regions of such a nebula to be something like 10^{-15} gm. per cm.^{3} We should then expect particles of 10^{18} gm., that is, one million million tons, to develop in 10^9 years. This is about the mass of one of the smallest asteroids. We do not suggest, however, that bodies of this size will go on condensing in this way undisturbed. We must expect particles of various size to combine occasionally to form still larger formations. On the other hand, especially in the denser regions near the central nucleus, the particles will run a great risk of being volatilised by violent encounters, and with increasing energy-density the temperature of particles will be too high to admit condensation

Further, inside Roche's limit around the centre no formation of large particles is possible Therefore there will probably be an optimum region for the formation of large bodies in the solar system, and we may assume this region to occur around the orbits of the giant planets Jupiter and Saturn We may mention here the well-known fact that the planet Jupiter contributes about 60 per cent of the total angular momentum of the solar system

The objection by H Jeffreys[6] to the 'planetesimal theory' of Chamberlain and Moulton that the planetesimals are likely to volatilise entirely before contributing essentially to the formation of larger bodies of small orbital eccentricities and inclinations does not apply generally in our case, since the condensed particles are likely to possess from the beginning only small velocities relative to the circular orbits in the plane of rotation of the nebulous mass In the extended solar nebula, viscosity will have produced at least roughly regular conditions, and because the pressure gradient is not likely to contribute much to support the gaseous matter against gravity, the mean motion of the gas, and hence the motion of the condensed particles, is likely to follow fairly closely the circular motion. I have further shown as a general theorem[7] that mild encounters leading to a dissipation of kinetic energy of the particles will, in the mean, lead to a concentration of the particles towards circular orbits in the plane of rotation. Still, owing to the large free surface per unit mass of the small particles, a very great number of these corpuscles will actually be evaporated by encounters, but some particles which succeed in growing without serious interruption will increase in size by accumulation of smaller particles at a rate probably exceeding considerably that of our condensation formula given above It appears, therefore, that the net result of the condensation process will ultimately be a rapid growth of a comparatively small number of large bodies We of course at once identify these bodies with the planets and their satellites

We may ask, incidentally, if there are in the universe types of objects which in any way resemble the primordial solar system as depicted above In actual fact, it is not unreasonable to assume that certain stars of early type with nebulous envelopes showing the reflected continuous spectra of the stars involved, which are not seldom observed in the Milky Way, constitute systems of a similar nature, that is, they consist of a stellar core inside a thin gaseous envelope which in the outer regions passes over into a meteoric cloud When, however, the central nucleus reaches a very high temperature, there must be a strong radiation pressure on particles of a certain size[8] In such a case we should expect not only an outgoing stream of small particles, for which radiation pressure increases with increasing size, but also an incoming stream of larger particles, for which the radiation pressure decreases with increasing diameter It is possible, further, that larger particles have formed at some time before the nucleus acquired by contraction a very high surface temperature Modern evidence[9] seems actually to indicate reflection by fairly large particles in the nebulous envelope We may assume that the types of objects in our stellar system which show the strongest galactic concentration have actually formed in the 'present phase' of the stellar system, that is, during the time in which the stellar system has possessed its present mass, angular momentum and invariable plane The minimum amount of time passed in this phase may perhaps be set down as 10^{10} years This seems to be near the upper limit of the age of the earth's crust If the sun, or rather the solar nebula, became differentiated out of the interstellar material in the present phase of the system, or during an earlier phase, seems therefore doubtful

Returning to the formation of the planets from the gaseous and meteoric material of the solar nebula, in accordance with the lines of thought just outlined, we assume that the earth has been formed around a heavy core by accumulation of a great number of particles of various sizes. In addition to the considerations dealt with earlier, we may direct attention to the circumstance that, between neighbouring particles formed by condensation of atoms of very large mean free path, and by accumulation of free particles of larger size, there will be a certain additional pull due to their shielding one another with respect to the free atoms or corpuscles falling in towards their surfaces As the accumulation may be thought to have been especially rapid at certain stages of the process, for example, in encounters with comparatively large bodies, the planet may ultimately have become heated to such an extent that at least the surface layers have been entirely in a fluid state, perhaps even incandescent A temperature of 2,000° of the radiating surface may be upheld, if material of a mean space density about 10^{-9} gm. per cm.^{3} falls in towards the radiating surface with a mean velocity of 10 km. per sec. At a later stage, through loss of heat by radiation, simultaneous solidification all over the surface has taken place

The formation of satellite systems is explained on general lines in a way analogous to the theory of formation of the planetary system itself. The fusion of particles of various sizes, leading to the formation of a massive planet, will in the first stage produce an incandescent nucleus with an extended gaseous atmosphere. The angular momentum due to the satellite system and the rotation of the planet taken together correspond to the angular momentum of the matter which was sufficiently near a planetary nucleus to be retained in its neighbourhood by gravitation, or in the course of time has been caught in encounters. The direction of rotation should therefore be the *same* as that of the system as a whole, and thus that of the planetary orbits, the few exceptions to this rule are readily explained as accidental deviations due to local conditions (the Uranus system and the satellite of Neptune) or capture in recent times (Jupiter VIII and IX, Saturn IX). The strong correlation between the angular momentum of rotation of the planet and the mass of the satellite system is readily understood Apparently singular objects like the satellites of Mars may be understood without making the assumption that these bodies have originated directly out of the mass of the planet.

The rings of Saturn are perhaps best explained directly as small particles formed by condensation inside Roche's limit for the planet in question The extremely flat formation is explained partly by the condensation of the particles out of a gaseous cloud, which causes the particles to follow originally nearly circular motions with low inclinations, but mainly by the influence of mild collisions between neighbouring particles, as explained by Jeffreys[10] and on somewhat different lines by myself in a recent paper[11].

The corpuscles of the zodiacal light have possibly been formed fairly recently[12] out of the last remnants, perhaps reformed by volatilisation, of the nebulous cloud surrounding the sun

Finally we must mention the probable status of the meteorites. Their division into, roughly, two widely different kinds, stony and iron meteorites, suggests that they can scarcely be considered exclusively as direct condensation products We may perhaps get a general explanation of their physical nature, as well as of their motions, which obviously differ very much from the circular orbits in the invariable plane of the solar system, by assuming that they are, generally speaking, remnants of larger bodies, shattered by violent encounters in the manner which has been considered above Like the planets, these larger bodies have therefore formed to a great extent by accumulation of smaller particles We can then assume, in conformity with the views put forward by geophysicists[13], that a certain sedimentation of the various minerals has taken place at a fairly high temperature in the bodies in question before their disruption Those meteorites which did not originally belong to our system have probably emanated from analogous systems in other regions of the Milky Way, forming showers of particles traversing the voids of interstellar space much like the stars themselves In regard to their origin they are, according to our point of view, largely a sort of by-product in the process of formation of planetary systems

[1] *Mon Not Roy Ast Soc*, in press

[2] "The Internal Constitution of the Stars", p 371, 1926

[3] *Phys Rev*, 8, 149 1916 *Proc U S Nat Acad*, 3, 141, 1917

[4] *Astrophys J*, 69, 7, 1929

[5] *K Sven Vetenskap, Handl*, 3, 13, No 2, 1934 (*Upsala Meddelande*, No 58)

[6] "The Earth", p 250, 1924

[7] *Mon Not Roy Ast Soc*, 94, 231, 1934

[8] Cf Schoenberg and Jung, *Astron Nachr*, 247, 413 (1933)

[9] Cf Struve, Elvey and Keenan, *Astrophys J*, 77, 274, 1934

[10] *Mon Not Roy Ast Soc*, 77, 91, 1916

[11] loc cit

[12] Cf H Jeffreys loc cit

[13] Cf G v Hevesy "Chemical Analysis by X Rays and its Applications" (Cornell University Publ 1932)

Deep Diving and Under-Water Rescue

SIR ROBERT DAVIS delivered the Thomas Gray Memorial Lectures for 1934 of the Royal Society of Arts, and spoke on deep diving and under-water rescue The lectures have now been published, they form a valuable study of the development of apparatus and technique, admirably illustrated and lightened by comments and anecdotes arising out of the author's lifelong experience of the subject

Divers have always wanted to get a little deeper, but the particular obstacle to be overcome has varied in successive generations. At first it was the matter of air supply, when the eighteenth century inventor and his victims "discovered by bitter experience that the leathern bellows, which worked so admirably when blowing an organ or smith's forge, were quite incapable of forcing air down to a diver" working at more than two or three feet deep Later, when the introduction of metal air pumps enabled a supply to be delivered at high pressure, came the mysterious, crippling, 'diver's palsy' which we now call compressed air illness Later still, when physiologists had elucidated the cause of this trouble and devised methods of slow decompression to avert it, came the economic difficulty that at depths of thirty fathoms and upwards, so much of the diver's time under water had to be used in decompression that only a fraction remained available for useful and paying work Now the invention of the Davis Submerged Decompression Chamber (see NATURE, August 29, 1931) has eased this situation and made salvage work in the rubber dress a practical procedure up to 300 feet depth; and there for the moment we rest.

The deep diver of to-day receives a measured supply of clean air from steam compressors An injector circulates the air from his helmet through an absorbent which removes carbon dioxide as fast as his breathing produces it He is in constant telephonic communication with the organisation in the salvage ship above, which not only controls his decompression but also, through the agency of such devices as grabs and pneumatic tools, takes over an increasing share of the manual work to be done on the bottom Expensive plant, once started, should run continuously, hence a succession of fresh divers is required who have to subordinate their procedure to the common plan of the team The famous divers of the past, some of whose feats Sir Robert described, worked almost single-handed in far greater danger and discomfort , only the fittest mentally and physically could attempt the deeper work and these few acquired outstanding skill and experience It may be that we shall not see their like again

More than fifty years ago one of these men, Alexander Lambert, struggled through 1,000 feet of the wrecked and flooded Severn tunnel in complete darkness to close an iron door and enable the water to be pumped out As it was impossible to drag such a great length of air pipe behind him, he used H A Fleuss's newly invented self-contained diving-dress, putting it on for the first time that day This was the prototype of the now familiar type of breathing apparatus in which carbon dioxide is removed from the expired air by passing it over caustic alkali, and the oxygen consumed by the user is replaced from a high pressure cylinder This system is in use in mine rescue and fire brigade smoke helmet apparatus all over the world to-day, but has perhaps been carried to the highest point of development and portability in the compact Davis Submarine Escape Apparatus, which now provides each member of the crew of all British (and many foreign) submarines with the means of breathing in suffocating gases or under water until the escape hatches can be opened, when it will waft him gently to the surface and support him there until help arrives

The Future of Tropical Australia

By Dr L Dudley Stamp

FOR more than a century the British Government, the colony of South Australia, and the Australian Commonwealth have attempted to develop the half million square miles contained within the Northern Territory More than £17,000,000 has been expended in the effort, yet to-day the entire population consists of some 3,000 whites, 800 yellow persons, 900 half-castes and probably 20,000 aboriginals The mining and cattle industries, once promising, have declined. The same state of affairs is found in the tropical parts of Western Australia, where the total non-aboriginal population is less than 2,000 It is only on the patches of richer soil along the coast of Queensland that the population of tropical Australia is relatively flourishing and increasing.

A few years ago, Prof Griffith Taylor[1] was almost alone in declaring that only three per cent of tropical Australia—entirely in the coastal belt of Queensland with its well-distributed rainfall—was suitable for tropical agriculture and consequent close settlement His views are gradually becoming generally accepted, but there is still a wide divergence of opinion on the reasons for the lack of settlement Sir James Barrett in a recent article[2] says, "It is generally assumed that there is a medical, or rather physiological, reason for failure to settle parts of tropical Australia So far as investigation goes there is nothing of the kind. The failure to settle some parts of tropical Australia and the successful settlement of other portions of the tropics is solely economic" In his consideration, he rightly divides tropical Australia into four regions (1) the coastal districts of Queensland with good soil and abundant rainfall , (2) the western portion of Queensland suitable for grazing , (3) the Northern Territory and (4) the northern portion of Western Australia similar in character to (3) He shows that in the last ten years the annual increase of population in tropical Queensland has been 2 per cent per annum, against 1·5 per cent for non-tropical Australia He finds that birthrate, infantile and general death rates in tropical Queensland compare favourably with those of many non-tropical countries, are better than those of metropolitan non-tropical Australia and are little if at all inferior to those of Australia as a whole

It is, as Sir James argues, unfair to consider the vital statistics for regions (3) and (4) because of the small size of the sample Economic nationalism and State socialism are blamed for preventing more rapid development of tropical Australia—"it is certain that it is not the effect of the climate on Anglo-Saxons" On the other hand, R. W. Cilento, director of Australian tropical hygiene, considers that the Commonwealth is evolving a new type of person—the North Queenslander—who "moves slowly and conserves his muscular heat-producing energy in every possible way"[3], thus agreeing with results of experiments carried out by American physiologists recently[4]. The vital statistics quoted by Sir James Barrett prove the efficient work of the medical services rather than the absence of climatic influence on life and habits

In a thoughtful and well-documented study[5], A Grenfell Price, of the University of Adelaide, has reviewed the attempts to settle and establish agricultural or other industries in the Northern Territory The thorough work of this geographer has been recognised by the award to him of the Commandership of the Order of St Michael and St George and the doctorate of the University of Adelaide in 1933 He has summarised his views on the major problem in a paper entitled "Pioneer Reactions to a Poor Tropical Environment"[6], and concludes that "there is little hope for anything more than a sparse pastoral population in the greater part of the Australian tropics and that this population will show strong reactions to a poor and difficult tropical environment There is, however, some possibility that Australians may permanently establish close settlement by white agriculturists in small and favourable areas, particularly on the east coast of Queensland"

Dr Isaiah Bowman[7] suggests that, so far as the Northern Territory is concerned, it would be better to "give up this painful experiment on an incorrigible frontier and let the land revert to wilderness"

If the land has now been properly assessed, the real danger of 'an empty north' to the 'White Australia' policy disappears Sir James Barrett points out the accessibility of the Northern Territory from densely peopled areas, such as Java, and argues that had conditions been suitable it would long ago have been colonised by Malays or Javanese On the other hand, there was not, perhaps, sufficient economic pressure to necessitate the inhabitants of the East Indies seeking settlement in lands less attractive The position to-day is somewhat different There is a close correlation between climatic and soil conditions in the region around Darwin and in some of the poorer parts of peninsular India Will the future alter the value of tropical Australia in the eyes of overcrowded India ? Darwin is clearly destined to remain on a major world aerial route, and in this connexion at least the Northern Territory cannot remain entirely empty

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[1] See *inter alia*, 'Australia, Physiographic and Economic", Oxford Third edition, 1923, pp 262-3

[2] "Tropical Australia", *Aust Quart*, No 21, 64-72, March 1934

[3] Quoted by A G Price, *Amer Geog Rev*, **23**, 371, July 1933

[4] D B Dill and others, "Physical Performance in Relation to External Temperatures" Fatigue Laboratory, Harvard University, 1931

[5] "The History and Problems of the Northern Territory, Australia". Adelaide, 1930

[6] *Amer Geog Rev*, **23**, 353-371, July 1933

[7] 'The Pioneer Fringe' New York, 1932, p 186

Obituary

SIR ALFRED EWING, K C B, F R S

JAMES ALFRED EWING, like many Scots who have become distinguished in the fields of literature and science, was a son of the manse He was born on March 27, 1855, in Dundee, where his father was a minister of what was then called the 'Free Church of Scotland', his father having 'come out' in the Disruption of 1843 In the autobiographical section of "An Engineer's Outlook", Sir Alfred described his father as a man who, with a superb physique, never missed a day's duty through illness, or shirked one for any reason, the same words might be applied to Sir Alfred himself He seems to have owed much of his early education to his mother As he so happily phrased it, "She gave us much of what other boys got at school, and did it in a way that made us associate a love of learning with our love of her".

From Dundee High School, Ewing proceeded in the early '70's to the University of Edinburgh, the first holder of an engineering scholarship in the gift of Dundee High School, and his career as a student was prophetic of the distinction he was to acquire in later life—the records of the Engineering Department show that during the session 1871-72 the prizeman in the class of engineering was James Alfred Ewing. It was his good fortune to be a student during the time when Tait and Fleeming Jenkin were at the zenith of their powers, and undoubtedly Ewing owed much of his zest for research to the inspiring influence of these two teachers Through Jenkin he was brought into contact with Sir William Thomson (afterwards Lord Kelvin), and he took an active share in the early development of submarine telegraph cables, making in connexion with this work three cable-laying voyages to Brazil and the River Plate

In 1878, on the nomination of Fleeming Jenkin, Ewing went to Japan as professor of mechanical engineering in the University of Tokyo, and there spent what he termed "five educative years". In the latter part of this service one of his duties was to undertake teaching in physics, and he there began his classical experiments on magnetism

It was while in Tokyo that Ewing married his first wife, Miss Washington, a great-great-grand-niece of the first president of the American Republic He had two children, born in Japan, by his first wife, who reached mature years before their mother's death In 1911, shortly before he was appointed to the principalship of the University of Edinburgh, he married as his second wife a daughter of the late Prof John Hopkinson, a past-president of the Institution of Electrical Engineers, by whom he had a son.

After five years service in Japan, Ewing decided to return home, although the Japanese authorities were anxious to retain his services for another two years He had been offered, however, the professorship of engineering in University College, Dundee, and there he had seven years of further experience in teaching and research

In 1890 Ewing was appointed to the chair of mechanism and applied mechanics in the University of Cambridge as successor to James Stuart. The last years of Stuart's occupancy of the chair had not been happy ones, as his attention had been largely diverted from engineering to politics and journalism, and the University was disinclined to continue the engineering department, if that were possible, fortunately, a wiser decision was taken By the generosity of donors, Ewing soon acquired a laboratory, where research work could be carried on and ordinary laboratory instruction given The school flourished, the number of students increased rapidly, and, in 1899, a generous gift in memory of Prof John Hopkinson from his widow and children provided the funds for a much needed enlargement of the laboratory buildings By 1903, when Ewing severed his connexion with the University of Cambridge, the Engineering School was one of the largest in the country, and its output of research testified to Ewing's great influence upon those working with him

In 1903, the Admiralty was about to introduce what was known as the New Scheme of Naval Education After an interview with Lord Selborne and Sir John Fisher, Ewing was offered the post of Director of Naval Education on very generous terms This opened up for him an entirely new sphere of work It meant that he had for the time being to abandon his researches and to drop his professional practice That this new scheme became a complete success was largely due to Ewing's extraordinary gift for administrative work, as there was opposition to some of the changes which had to be introduced

When the War broke out in 1914, Ewing was still Director of Naval Education, but almost at once he was asked to undertake an entirely new and onerous duty, namely, the problem of dealing with enemy cipher This led to the creation of a department which came to be known as "Room 40". The work carried out in Room 40 was strictly secret, and no section of our defence work was more unknown to the general public and to the enemy The secrets of Room 40 have never been divulged, though Ewing himself removed the veil slightly in a lecture he gave before the Edinburgh Philosophical Institution in 1927 Prior to this, the late Lord Balfour, then Chancellor of the University of Edinburgh, disclosed the fact that Ewing had been the head of the organisation in Room 40

It was while carrying on this work that Ewing was invited in 1916 to fill the dual office of principal and vice-chancellor of the University of Edinburgh. He was somewhat averse to undertaking this fresh burden, but was persuaded by the late Lord Balfour to accept office, while still continuing his work at Room 40, and it was not until May 1917, when he handed over the control to Admiral Sir Reginald Hall, that he was able to devote himself unreservedly to his University duties.

When he accepted office at Edinburgh, Ewing was sixty-two years of age, and it is a striking testimony to his extraordinary capacity for work and to his bodily vigour that, starting at that late age in an entirely new sphere of work, he was able in the twelve years of his principalship to accomplish such great and far-reaching changes in the development of the various departments of University life He realised that the War had brought many new problems in education and industry, and that the great universities would have to play a very important part in the necessary solving of these problems. Rapid developments in specialised study made it essential to found new chairs and lectureships, and during his term of office at Edinburgh no less than thirteen new chairs were established—six in the Faculty of Arts, four in the Faculty of Medicine, and three in the Faculty of Science— besides a number of lectureships in new subjects or in some of the older subjects where the teaching had to be extended A new degree in commerce was established, and the degree of Ph D was instituted in the hope of encouraging post graduate work and research The increase in the number of the teaching staff involved as a corollary an extensive scheme of new buildings It was impossible to find a site for the necessary new buildings in the immediate vicinity of the Old College, and Ewing decided to recommend the purchase of a large area of ground about a mile and a half south of the Old College, where during his principalship independent blocks were erected for chemistry, zoology and animal genetics, while plans were prepared and finances provided for new blocks for geology and engineering, built, however, after he had retired These blocks of buildings, known as King's Buildings, will remain as a permanent memorial to Ewing's term of office as principal of the University of Edinburgh

Needless to say, such an extensive increase in the number of teaching staff and the erection of these buildings involved very heavy expenditure Fortunately, Sir Alfred had a very persuasive tongue, and he was able to secure handsome gifts from private benefactors and public trusts, running into a total of more than three-quarters of a million sterling, and was thus able to carry through his improvement schemes without laying any serious burden upon general University finances.

During his twelve years of office, crowded as they were with administrative and social duties, Ewing was still able to find time to carry on research work, which had been his chief pleasure and object in life. He was an active member of many of the special committees of the Department of Scientific and Industrial Research, being chairman of the Bridge Stress Research Committee, which issued a valuable report in 1928 The necessary experiments on railway bridges throughout the country had to be carried out usually during week-ends, week-ends which an ordinary man at Ewing's age would have given over to rest and recreation, especially after he had spent the previous five days in strenuous University work He was also chairman of the Timber Mechanics Committee, and so recently as July 1934 that Committee issued a report, largely the work of Ewing himself. There can be little doubt that Ewing habitually overworked himself during the last three or four years of his life—work was his passion, especially research work, and it was to research work that he devoted his main energies during his last years

It is interesting to remember that, as Ewing began his university career and his life's work more than sixty years ago in the engineering class-room of the University of Edinburgh, so he made his last public appearance in the lecture room of the engineering department only last October, when he delivered an address entitled "For Better or Worse" to the members of the Associated Science Societies of the University How much he was beloved by the students of the University was attested by the fact that he was known to them by the affectionate nickname of "Alfy", and, at the conclusion of his last address, after the formal vote of thanks had been proposed and carried, the student audience rose to its feet and gave, as only students can, three rousing cheers for "Alfy".

Ewing's last years were largely occupied by the thought that man's ethical development had not kept pace with the advance of science, that science and engineering had placed in the hands of mankind tools which man had not yet learned to use wisely This formed the main theme of his remarkable presidential address to the British Association for the Advancement of Science at York in 1932 In "An Engineer's Outlook", published two years ago, one of the reprinted lectures was the Hibbert Lecture, delivered at the University of Cambridge in February 1933, on "Science and some Modern Problems" This lecture summed up Ewing's creed, after sixty years of active life in the service of education and science, he could find no better principle to urge on his listeners than the old gospel of goodwill—"*Thou* shalt love thy neighbour"—this, he said, is not a mere general injunction, it is an individual message

Ewing was the recipient of many honours. He held honorary degrees of the Universities of Oxford, Cambridge, Durham and St. Andrews He was elected a fellow of the Royal Society in 1887, and in 1895 received a Royal Medal for his researches on magnetism. He was elected an honorary member of the Institution of Civil Engineers in 1929, and of the Institution of Mechanical Engineers in 1932. He was made a Companion of the Bath in 1907, and Knight Commander of the same order in 1911. He was the author of many papers on scientific subjects, published in the *Transactions of the Royal Society* and other scientific societies His textbooks include "Magnetic Induction in Iron and Other Metals"; "The Steam Engine and Other Heat Engines", of which many editions have been issued, and which has been translated into many languages; "The Mechanical Production of Cold", "Thermodynamics for Engineers" and "The Strength of Materials".

T. HUDSON BEARE.

Sir Alfred Ewing and his Cambridge Chair

The Jacksonian professorship of natural and experimental philosophy at Cambridge is an old foundation dating from 1783 It was the duty of the professor to give experimental lectures on "Natural Experimental Philosophy and Chymistry", and the chair had been held by a succession of distinguished men In 1875 it was vacant through the death of Prof Willis, who had been its occupant for nearly forty years His predecessors had been chemists

By 1875 it was recognised that the study of the natural sciences deserved fuller encouragement Maxwell, a few years previously, had been appointed to the chair of physics Foster was lecturing as a Trinity prælector, Frank Balfour was beginning his work on comparative anatomy, and Liveing was teaching chemistry to an ever increasing number of students It was clear that he needed help, the Jacksonian professorship again became a chemical chair and Dewar was invited to fill it

At the same time, it was felt that mechanism and applied mechanics should still have a place in the University course, there was a man in Cambridge who could carry on some part at least of Willis's work, and so a professorship of mechanism and applied mechanics, to "terminate with the tenure of office of the professor first elected" unless the University should determine otherwise, was established, and James Stuart became professor There were some, Coutts Trotter for example, who, even then, sixty years ago, realised that the scientific study of engineering was a fitting subject for inclusion in the scheme of an ancient university It was a long step from this appointment to a professorship of engineering It was to be the duty of the professor to lecture on the principles of mechanism, the theory of structures, the theory of machines including the steam engine and other prime movers

There was an ordinary degree in mechanism and applied science, for which students were advised to read parts of Weale's Rudimentary Series, Balfour Stewart's "Heat", Bird and Brooke's "Elements of Natural Philosophy", and Ganot's "Physics". There was no laboratory, no provision for experimental work. But the professor started his work He raised funds for a certain amount of apparatus, some tools and workshop appliances, which ultimately were taken over by the University. A shed was erected to hold these, and by slow degrees the work grew

Some ten years later (1886–87), there was much controversy as to the place workshops should hold in a scheme for an honours degree in engineering then under discussion. A syndicate appointed to investigate among other things the "whole question of the workshops" was granted, in 1890, "further powers to enquire whether it be desirable to develop further the Engineering School in the University on the lines suggested" in a memorandum it had issued, and as a result, on November 10, 1892, the Mechanical Sciences Tripos was established The Tripos was to be in two parts covering the usual subjects of examination for an honours degree in engineering, together with—an addition of 1895—a paper of essays having "reference to the fundamental principles, history, philosophy or applications of the Mechanical Sciences"

Meanwhile, Prof Stuart had resigned and, to quote the "University Calendar", in "1890 J. A Ewing, B Sc Edinb" had been appointed professor He came, personally unknown to us, but with a distinguished career as a teacher at Tokyo and Dundee, a pupil of Lord Kelvin, the author of papers on magnetism of outstanding merit In 1881 he had described the effects which follow the application of a cyclical process of magnetisation to iron and other material, that tendency of the magnetisation to lag behind the application of the magnetising force, to which he gave the name of *hysteresis*, and in 1885 had contributed a striking paper to the Royal Society entitled "Experimental Researches in Magnetism"

Ewing established himself at once as a *persona grata* to the University, a colleague, soon to be our leader, whom some of us who had been active in urging that engineering should receive full recognition from the University welcomed whole heartedly among our ranks To his wise judgment and sane advice are due the general acceptance of the scheme of education proposed The debt due to him by the University may perhaps be measured by the success of that scheme which, aided by his staff, Peace and Dalby and Lamb, he developed for the next thirteen years

A committee was set up in Cambridge to obtain funds for the establishment of an adequate laboratory for the teaching of engineering in the University Sir J J Thomson, Prof Newall, Sir Napier Shaw and myself are the sole survivors Ewing was the treasurer We had the help of a large and distinguished general committee which contained the names of all the great engineers of the day We stated that £20,000 would be required for the complete design, but that much could be done for £4,000 or £5,000, and with the money so raised the Engineering Laboratory made its start What it has now become engineers are well aware

The first Tripos examination was held in 1896, Ewing, Osborne Reynolds, and Shaw were the examiners, seven candidates passed, of whom three were placed in the first class Now the Engineering Tripos list is among the largest in the University

Since those days, Sir Alfred has done more great work for his country In Cambridge he will ever be remembered as the founder of the Engineering School, the man who taught the University what science, so long at home there, might do for industry and how that task might be achieved

R T GLAZEBROOK

Sir Alfred Ewing and Naval Education

THE connexion of Sir Alfred Ewing with naval education came about through the decision of the Admiralty, in 1902, to carry out a root and branch reform of the training of officers and men in all sections of the Navy The reform was long overdue, for even up to 1901, junior officers spent a part of their time in learning to manœuvre ships under sail, although for all practical purposes sails in warships had been obsolete for thirty years Then, too, there was the urgent problem of the staffing of the engine rooms of the steadily increasing fleet, a problem rendered difficult by the failure of successive Boards of Admiralty to adjust the status of naval engineers in accordance with their responsibilities.

Though at the beginning of the century, naval training was discussed in many quarters, the credit for the re-organisation of naval education in 1903 to meet modern requirements belongs in the first place to Lord Fisher (then Admiral Sir John Fisher), who had recently become First Sea Lord The first step in the reform was the publication in December 1902, over the signature of Lord Selborne, of the famous "Memorandum dealing with the Entry, Training and Employment of Officers and Men of the Royal Navy and of the Royal Marines" That memorandum stated that "In the old days it sufficed if a naval officer were a seaman, now he must be a seaman, a gunner, a soldier, an engineer, and a man of science as well", and that "the three branches of the Service which are essential to the fighting efficiency of the Fleet—the Executive, the Engineer and the Marine" were to be recruited by one system and all officers were to be trained alike up to a certain age

These were ideas entirely new to the Service and to carry them into effect it was obvious that the Admiralty would require a man of outstanding reputation Their choice fell on Sir Alfred Ewing, who in the preface to his book, "An Engineer's Outlook", tells of his first visit to the Admiralty, when he met Lord Fisher, "that volcanic personality whom, later, I was to see often in quiescence and in eruption, and to learn something of his greatness". This visit led to Lord Selborne offering Sir Alfred the appointment of Director of Naval Education.

To a civilian, the task Sir Alfred undertook might well have appeared a complex one, for in the course of a few months he found himself responsible for the training given in the Royal Naval College, Greenwich, H M S *Britannia*, the new Royal Naval College at Osborne, the Royal Naval Engineering College at Keyham, the Dockyard Schools at Portsmouth, Chatham and Devonport, various training establishments for seamen, stokers and artificers, together with the supervision of the work of some eighty naval instructors of university standing, many of whom were serving on distant stations. The Selborne-Fisher scheme naturally cut across many traditions and found not a few critics, while from the members of the Board of Admiralty Sir Alfred received every assistance, among those below them he was sometimes conscious of cross-currents

From the beginning it was realised that the new system of training would have to be modified in the light of experience, and many changes have been made It may, however, safely be said that naval education to-day owes more to the work done by Sir Alfred Ewing between 1903 and the War than to any other single individual.

EDGAR C. SMITH.

News and Views

Mr. Lloyd George's Plans for National Development

MR. LLOYD GEORGE, outlining at Bangor on January 17 his proposals for national development, said that the supreme paradox of our generation is that millions of people are living in poverty and despair, not because of scarcity but because of over-abundance. Foremost among the problems of to-day and to-morrow is the question of securing peace among the nations, since whatever economic and social system is built up, unless it is based on peace, it will be founded on a quicksand. Next there are the obstacles to world trade, commerce and shipping which have multiplied enormously in the last few years. We are to-day confronted with a twofold problem, first of temporary unemployment due to abnormal conditions, and secondly of permanent unemployment which cannot be absorbed under the existing system. Our aim should be to find work for the workless instead of providing doles, and where private enterprise has been proved to be palpably unable during the present emergency to solve our national difficulties, the administrative and financial resources of the nation as a whole should be made responsible for setting on foot and supporting those developments in town and country which would bring our unutilised labour, our idle capital and our undeveloped resources into fruitful activity. Something on these lines has been attempted here and there—in housing, roads and other public works—but where it has been done, it has been done sporadically and inadequately.

MR. LLOYD GEORGE'S main proposal is that a permanent body should be set up for the purpose of thinking out and preparing schemes of reconstruction which would provide useful and necessary work. The functions of this Development Council would be to take a survey of the industrial, agricultural and financial resources and potentialities of Great Britain, to prepare and approve plans for industrial organisation, land development and the like, and to concede the application of the national credit with the view of properly financing the programmes it decides to carry out. Its duties would include the putting forward of recommendations to enable any important branch of industry, such as coal, cotton, iron and steel, shipping or agriculture, to re-organise itself, where the authority and the financial credit of the State may be needed to ensure proper measures being taken. Further scope for its activities would be found in meeting the lamentable deficiency of decent houses, in road improvements, in the development of railways and canals, in the development of telephones, electricity and water supply and in land settlement. Mr. Lloyd George also advocates a fundamental change in the constitution of the Cabinet. In an emergency like this, the Cabinet should consist of a small body—not more than five—of the ablest men available and not of about twenty men immersed in the detailed administration of gigantic departments of State.

General G. Ferrié (1868–1932)

THIS great and singularly attractive man died so long ago as February 16, 1932, but we did not succeed in obtaining an obituary notice of him. Many of our readers who knew him or his work will therefore be interested to learn of a series of eulogies and accounts of his life (*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, **133**, Oct. 1934, pp. 533–564). They include a funeral oration broadcast from Paris on the day of his death by Lieut.-Col. P. Brenot, a discourse given at his funeral two days later by M. R. Bourgeois, president of the Paris Academy of Sciences, a lecture on March 10, 1932, to an association of Engineers' regiments, by Lieut.-Col. P. Brenot; discourses by General Perrier and M. Painlevé (then Air Minister) at the inauguration of the plaques bearing the title of the newly-named Avenue du Général-Ferrié, at the Champ du Mars, October 10, 1932, a discourse of November 15, 1933, by M. Emile Picard, at the inauguration of a monument to General Ferrié, near the radio-telegraphic station at the Champ du Mars; a discourse by M. René Mesny, November 17, 1933, at the Academy of the Marine, and discourses by MM. J. Paraf and de Valbreuze, at the inauguration of a memorial medallion at l'École supérieure d'Électricité, Malakoff (Seine), where General Ferrié for many years gave and directed instruction in radio-telegraphy.

BORN in Savoy in 1868, Ferrié entered l'École Polytechnique in 1887 and was sub-lieutenant in the 'Engineers' in 1889, specialising in telegraphy in 1893. His introduction to radio-telegraphy came in 1898, when he studied the Hertzian waves after the publication of Marconi's first experiments. In 1899 he assisted in Marconi's famous experiments in radio-communication between Folkestone and Boulogne, and shortly afterwards was appointed by the Minister of War to develop the military applications of this new mode of communication. For many years he carried out this task with very little material or financial support, and battled magnificently against official inertia and incredulity. Gradually his ability, his faith, his energy, his initiative, his organising power, his devotion, led to successes which gained for him growing recognition and support. He built up a military radio organisation, first tested in the Morocco campaign of 1908, in which he took part, and enormously and most effectively expanded during the War of 1914–18. In 1903 Ferrié instituted the radio station at the Eiffel Tower, whence, later, in conjunction with the Paris Observatory, he transmitted the time signals which have played so important a part in subsequent progress in time and longitude determination. After the War, Ferrié took a most honoured place in international scientific work, being president of the International Commission of Longitudes by Radio-Telegraphy, and of the International Union for Scientific Radio-

Telegraphy. He was honoured in very numerous ways by scientific bodies in France and in other countries. In 1930, by a special law, he was made General for life, a signal testimony to the place he had attained in the esteem of his country Not only was he respected and admired for his ability and power, but also all who knew him loved him for his courtesy and his goodness of heart

Bequest for Bacteriology at Edinburgh

MRS CAMERON, widow of Lieut Col Lewis Cameron, Indian Medical Service, who died at St Helier, Jersey, in 1930, bequeathed all her estate and effects to the University of Edinburgh and directed that the fund, to be known as 'The Lewis Cameron Fund', should be utilised in establishing a yearly prize for the best paper on bacteriology or on the diagnosis of disease by students of the University The estate amounted to £103,771 This amount was regarded by the University as out of proportion to the purpose of the bequest The University gave an undertaking to Mrs Cameron's executors that they would make application to the Court of Session for a scheme for the regulation of the purposes affecting the estate, and on January 14 the Court approved the administration of the fund as follows £3,000 for the establishment of two yearly 'Lewis Cameron' prizes of £50 each, one open to undergraduate students and the other to post-graduate students of the University for the best papers on subjects related to bacteriology or to the diagnosis of diseases, £15,000 for the endowment of a 'Lewis Cameron' teaching fellowship in bacteriology, £15,000 to stabilise by endowment one of the existing lectureships in bacteriology, £10,000 to form a 'Lewis Cameron' research fund, and £10,000 for a 'Lewis Cameron' library fund to provide books relating to bacteriology and the diagnosis of disease The remainder of the estate, about £50,000, is to be set aside as the nucleus of a building fund for providing additional accommodation and equipment in the University for teaching of the sciences bearing on the diagnosis of disease and for research in these sciences. It is hoped that allocation of this sum for buildings may enable the University to obtain assistance from other sources, and so make possible an extension of the medical buildings and of their equipment necessary to maintain the reputation of the University as a centre of medical education and research.

Exhibition of Primitive and Chinese Art

Two exhibitions of objects of art are being arranged for this year, which will be of no little scientific, as well as æsthetic, interest Of these, the first will illustrate the art of primitive peoples. This exhibition will take place in May next and will be held under the auspices of the Burlington Fine Arts Club. Although the various schools of primitive art, if that term may be used, are well, and on the whole fully, represented in the national and public collections, examples must as a rule be subordinated to the general scheme of museum arrangement, and other material distracts from their proper appreciation If, as no doubt will be the case, representative series are shown, their close association within the compass of a single exhibition should lead, by force of comparison and contrast, to an extended perception among the general public of the variety of primitive art in ideals, technique and achievement, as well as to a clearer understanding of the part played by artistic products in relation to the life and mentality of the peoples who have produced them On the other hand, it may be anticipated that the primitive will not be without effect on the more sophisticated culture The influence of African art in wood and ivory carving on the development of modern schools of art in painting and sculpture early in the present century will serve as a reminder that primitive art is not without something more than antiquarian interest in the theory of æsthetic.

THE second exhibition is of an entirely different character and will be the product of international co-operation on an extended scale The Royal Academy has arranged to hold an exhibition of Chinese art from November 1935 until March 1936 The King and Queen and the President of the Chinese Republic will be patrons, and the exhibition will be held under the auspices of the British and Chinese Governments As it is intended that the exhibition should illustrate fully the art and culture of the Chinese from early times down to 1800, a unique opportunity will be afforded for placing China in something like true perspective in the history of world civilisation The art of China, as is well known, played no inconsiderable part in the development of the art and culture of Western Europe from the eighteenth century onward, but this was only at a late phase in a remarkably long line of development In this exhibition the association of 'classical' with the products of early and prehistoric culture, especially in the instance of the last-named of the more recently discovered, to which additions are being made continuously, will serve as a much-needed corrective of some popular misconceptions of the standing and achievement of the Chinese as a people It may possibly also serve the useful purpose of stimulating a more active interest in their own antiquities among the Chinese themselves An influential organising committee has been appointed with Lord Lytton as chairman, and Mr Laurence Binyon, Mr R L Hobson, Sir Neil Malcolm, M Paul Pelliot and Prof Perceval Yetts among its members. This committee will co-operate with a local Chinese committee of State officials under the presidency of the Minister for Education in the selection of exhibits from China Other exhibits will be drawn from collections in Japan, Europe and America.

History of Dyestuffs in Great Britain

MR C T. J. CRONSHAW, director of the Dyestuffs Section of Imperial Chemical Industries, Ltd, is this year's Jubilee Memorial lecturer for the Society of Chemical Industry, and he spoke under the title "In Quest of Colour" before a joint meeting of that society with the Institute of Chemistry in Newcastle on January 15 This proved to be a comprehensive account of the history of the dyestuffs industry in Great Britain, and traced the development and expansion of the chemist's skill and the dyer's needs since Sir W. H. Perkin's original discovery in 1856 Perhaps the most interesting section of the address was the examination of the causes which produced the rise, and then, in England, the decline of the new manufacture In the first place, the time was ripe for such a discovery because the successful application of machinery to the textile industries and the increase in available wool (from Australia) offered almost unlimited expansion, and also as England was a wealthy country and the workshop of the world As for the decline, Perkin himself attributed it to three causes the Patent laws, the ease of infringement abroad, and foreign import duties Others have blamed the textile manufacturers and the greater facilities for scientific publication in Germany at that time, but Mr Cronshaw placed above these, lack of foresight, and the fact that the leaders of the industry retired too soon Perkin was certainly the leading technologist of his day, and he retired at the age of thirty-six years, Caro at thirty-five in 1869, and Nicholson in 1868 Perhaps the early success was too easy, and proved to be dearly bought

Queen Maud Ranges of Antarctica

THE American expedition to the Bay of Whales in the Ross Sea is reported by *The Times* to have undertaken a most successful dog-sledge expedition to the Queen Maud Ranges, which amplifies the work of Dr L M Gould of the previous Byrd expedition of 1929–30 A party of three under Mr Q A Blackburn reached the Thorne glacier, which lies in about lat 86° S, long 153° W, and then ascending the glacier reached the surface of the polar plateau at an elevation of about seven thousand feet The ranges appear to continue with decreasing heights to the north of east This direction may lead to Coats Land in the Weddell Sea or possibly towards Hearst Land At the top of the glacier, deposits of coal are reported to have been found This would appear to be the same deposit found on the Beardmore glacier and the carbonaceous layer found in the flank of Mount Nansen. There is thus a confirmation of the suggestion made some years ago by Sir Edgeworth David of a great coalfield associated with the Beacon sandstone of the polar plateau The brief cabled report also refers to a subplateau at an elevation of 2,500 ft between the Ross Sea ice and the level of the polar plateau This was called the Leverett glacier in 1929 The sledge party reached three degrees from the Pole before turning back, and altogether covered 1,410 miles in 88 days

Effect of Rough Seas on Marine Structures

ON February 2–3, 1934, a storm of exceptional severity was experienced along the northern coast of Africa and led to the destruction of more than 1,300 ft. of the recently constructed Mustapha Breakwater at Algiers. The storm and the damage done is described by Dr. B. Cunningham in *Engineering* of January 11 There are several moles protecting the Port of Algiers, but whereas the older ones are rubble mounds, the Mustapha Breakwater consisted of a vertical wall 11 m thick with its base resting on a rubble foundation 50 ft below mean sea-level It was recognised as one of the finest examples of its kind The wall successfully withstood a severe storm on December 31, 1933, when it was subject to waves 6–6½ m in height and 100 120 m in length, but was completely destroyed by the storm of February 2–3, 1934 Observations made during this storm showed that the wall was being subject to the action of waves 9 m in height, 200 m long and with a period of 13½ seconds, and photographs taken show unbroken masses of water 2 6 m thick passing over it There were three stages in its destruction (1) erosion of the bed of the sea in front of the rubble foundation, (2) the sudden removal of the rubble foundation by one or more great waves, and (3) the excavation by the sea of a trench into which the wall collapsed It has been generally thought, says Dr Cunningham, that a level of about 40 ft below the sea-surface marked the limit of appreciable dislocation of rubble foundation mounds by wave action, but this view now needs reconsideration, and it is clear that the effective suction of a back draught following wave stroke may extend to depths far below the accepted standard Fortunately, the failure of the mole did not lead to damage to shipping in the harbour It has now been decided to replace the wall at once with a breakwater of the classic mound type.

Removal of Smoke and Acid Constituents from Flue Gases

PRACTICAL remedies for preventing or reducing the emission of objectionable constituents in flue gases have in the past been mainly confined to the elimination of grit and dust emission In large urban areas it is now realised that the acid emission is attended with more serious consequences In 1927, Parliamentary sanction was only given to the erection of Battersea Power Station on the condition that the best practicable means should be taken to remove the oxides of sulphur from the flue gases In a paper on a new method of removing smoke and acid constituents from flue gases read on January 7 to a joint meeting of the Institute of Fuel and the Institution of Electrical Engineers by Dr J L Pearson, G Nonhebel and P H N Ulander, it was stated that the daily combustion of 1,000 tons of average coal in addition to grit, dust and tarry matter, leads to the formation of 45 tons of sulphuric acid, 3–7 tons of nitric acid and half a ton of hydrochloric acid It is clear that when wet washing is applied, a non-effluent system must be used The new system is a recirculating, non-effluent water system, from which the grit, dust and ashes are separated and removed as solids A pilot plant was erected at Billingham, and was subjected to a twenty-months' running test The water used was a hard surface water drawn from a local stream Lime was used as the alkali for most of the test, and chalk was used for the remainder. Very satisfactory results were obtained 97–99 per cent of the sulphur oxides were removed, 90–93 per cent of the hydrochloric acid and 97–98 per cent of the grit and dust from the pulverised fuel boiler. The exit gas from the plant is so free from sulphur dioxide that it is practically odourless, although the sense of smell can detect a very minute trace of this gas

River Flow Records

The paper on "Flow of the River Dee" (Aberdeenshire), by Capt W N McClean, read before the British Association meeting at Aberdeen last September, has been issued in pamphlet form, reprinted from *Engineering*, with a memorandum which indicates the progress made in the survey of the river subsequent to the original date of the paper, and an addendum illustrating the manner in which the records are to be set out in tabular form for publication The Dee has a catchment area of 790 sq miles to Aberdeen, and for the purposes of the survey it was divided into four subsidiary areas, with flow gauging stations at Balmoral, Dennet, Cairnton and Cults The author states that he has found that the summer flow in certain Scottish rivers of about 100 to 700 sq miles catchment, may be taken, roughly, as from 1/5 to 1 cu ft per sec per sq mile, according to area Flood flows are much more complicated. The author further notes the difficulty of measuring low flows with current meters, as they are at present not very reliable for velocities of less than 1 ft per sec He suggests the difficulty may be overcome in the future by a temporary contraction of the channel, so as to increase the velocity Two types of apparatus are in use on the Dee . namely, one in which the meter is suspended from a wire and another in which a rod is the means of support. It is known that, in turbulent flows, the wire-suspended meter tends to set to the current and to give excessively high values The combined use of the two methods enables a serviceable comparison to be made of their respective accuracies The records obtained should prove of great public utility and the co operation of two authorities directly interested, the City of Aberdeen and the Fishery Board of the Dee, has been secured in establishing the gauging stations Capt McClean points out that if there were a recognised association for these river records, the water interests would become subscribing members of the association, receiving the completed records in return for the standard tables of water levels prepared by themselves

Thunderstorms in Great Britain

The third annual report of the survey of thunderstorms in the British Isles, entitled "Summer Thunderstorms", has been received (Huddersfield: Thunderstorm Census Organisation 2*s*. 6*d*) Much of it has been written by Mr S. Morris Bower, the honorary director of the Survey, but articles have been contributed by Sir C V Boys on "Progressive Lightning" and by S T E Dark on "Trees Struck by Lightning" The Survey is an amateur enterprise somewhat similar to what the British Rainfall Organization was in its early stages. Its development is doubtless made more difficult because the economic importance of the distribution of thunderstorms is, at present, less than that of rainfall. There is the further difficulty that the study of thunderstorms cannot be effectively prosecuted apart from the general study of synoptic meteorology, except in limited directions In the purely statistical problem of obtaining the best possible cartographical representation of the occurrence of thunder, the Survey had the advantage in 1933 of a number of voluntary observers—1,291—nearly four times greater than the number of full climatological stations co-operating with the Meteorological Office, an advantage greater than the numbers alone suggest in that the observers at official stations do not concentrate on one phenomenon This report deals with some of the statistical results obtained in 1933, and also includes maps showing the number of days on which storms occurred in different parts of the British Isles in each of the months April–September 1932 The frequencies shown give the number of civil days during which one or more thunderstorms pass over head, and are therefore not comparable with figures based on the international definition of a day of thunderstorm at any place as one on which thunder is heard at that place The article on "Trees Struck by Lightning" is accompanied by some interesting photographs showing spiral scoring of tree trunks; it can be seen that the lightning may descend the tree either in a left or a right hand spiral Sir C V Boys's article deals with photographic studies of the duration and length of individual flashes, their direction and velocity, and suggests means for initiating a flash by firing a rocket into the thunder cloud, to assist in studies of this kind

The Imperial Forestry Institute, Oxford

In the tenth annual report of the Imperial Forestry Institute for the year 1933–34 (Oxford: The Holywell Press Ltd , 1934) it is stated that the number of students was still considerably below normal, owing to the stoppage of the recruitment for the forest services of the Colonial Office, though it compared favourably with the number of the previous year Apart from regular students, a number of forest officers, at home on leave, and others attended the Institute for short periods to work in the libraries and the laboratories The Institute is still shorthanded so far as the staff is concerned. During the year, a decree was passed by the University allocating a site within the Parks area for the erection of a new building for the Department of Forestry, including the Imperial Forestry Institute. Some progress has been made in regard to preliminary plans and estimates for the building , but it has not yet been possible to commence building operations owing to lack of sufficient financial provision , this matter, it is said, is receiving further attention. The income of the Institute is made up of grants from the Crown Agents, Dominions and others, Forestry Commission, and the Department of Scientific and Industrial Research An interesting part of the report is given to a record of the progress which is being made with the collection and identification of the species of the forest floras of the various Colonies and Protectorates. Details are given under the Colonies grouped under West Tropical Africa, East Tropical Africa, South Central Tropical Africa, the South Temperate Region and a few other territories. The report gives full details of the various branches of work upon which the Institute is engaged, including brief accounts of the tours abroad undertaken by the students and others attending the courses.

Plant Breeding in the U.S.S.R.

THE Bureaux of Plant Genetics at Cambridge and Aberystwyth have published jointly a bulletin of 58 pages (price 3*s.* 6*d.*) on plant breeding in the Soviet Union. This is mainly a translation from the Russian of an address given by Prof. W. I. Vavilov at a conference on the planning of plant breeding and genetics investigations, held at Leningrad in 1932, and is followed by a detailed programme of work on different economic plants. The congress effected a reorganisation of the various genetical institutions in Russia and the adoption of a new system of fourteen plant breeding centres. This bulletin will be of service to all who are engaged in plant breeding, particularly on the practical side. It sets forth in outline the immense collections of economic plant material which have been made by expeditions to many parts of the world, notably Afghanistan, Kashmir, Abyssinia, Mexico, Bolivia and Peru. These embrace more than 200 crops, including 29,200 living specimens of wheat, 13,000 of barley, more than 9,000 of maize, 1,000 of potatoes, etc. There has resulted the conception of geographical centres for the production of varieties of many crops. The work includes cereals, vegetables, fruit trees, medicinal and fibre plants, etc. A series of new potato species with diverse characters and multiple chromosome numbers was found in the Andes. The vast amount of breeding work in progress and projected during the second five year plan (1933–37) is outlined in the latter part of the bulletin.

Grassland Research

THE Imperial Economic Committee has issued its report (No. 27) on grassland seeds (London: H.M. Stationery Office. 1*s.* net). As grass may be regarded as the vital raw material of most of the produce of livestock, and farming and grassland products accounted for more than 20 per cent of the value of all imports into the United Kingdom in 1932, the importance of good grassland management cannot be over-emphasised. The discovery that local strains are, for their own locality, often superior to commercial strains as regards persistence and leafiness has opened the way for considerable improvements, but even greater advances are being made by the production of pedigree strains at the plant breeding stations. If, however, economic benefit is to be gained from all this experimental work, far-reaching changes in organisation of the seed industry will be needed. The primary task is that of ensuring an adequate supply of stock seed of the pedigree strains and of maintaining them true to type when they pass in commercial quantities through the ordinary channels of trade, and to achieve this end the breeding stations will need to be supplemented by seed farms. In this connexion, the report gives particulars of schemes for seed certification and other methods which have been adopted in various countries, notably in Sweden, Canada and New Zealand, and the success with which such schemes have met suggests that districts such as Northern Ireland, where considerable quantities of rye-grass seed are produced annually, might benefit from a similar type of organisation if combined with the experiments now in progress with improved stock seed.

Farm Pumps

AN illustrated booklet entitled "Pumps for Farm Water Supply" by C. A. Cameron Brown of the Institute for Research in Agricultural Engineering, Oxford, has just been published (Oxford Univ. Press, price 1*s.* 6*d.*). Its appearance is opportune although plans for its preparation were made before the drought in 1933 and 1934 had rendered the question of rural water supplies such an urgent matter. The inquiry has been carried out particularly with the view of helping the farmer and isolated small country house dweller to obtain an adequate water supply from whatever source may be available at as low a cost as possible. Small electrically driven pumps capable of delivering upwards of 250 gallons per hour are available at prices from £10 to £12. No pump should be installed without an assurance from the makers that it will give the performance required to meet the particular set of conditions in each particular case, but with this proviso they should prove entirely reliable. The gravity tank is still the commonest, and probably the simplest, method of providing service, but the pressure-tank system has an advantage where the installation of a gravity tank presents constructional difficulty or is likely to be unsightly, but it is at a disadvantage in districts where electricity supply failures are frequent. The actual running cost of these small pumps is low in comparison with the cost of public water supply in towns. Test figures under working conditions show from 0·66 electrical units to 1·89 units per 1,000 gallons.

Zoological Society of London

AT the monthly general meeting of the Zoological Society of London it was stated that the total number of visitors to the Society's Gardens during the year 1934 was 1,639,611, the receipts amounting to £50,969, an increase of £3,432 as compared with the previous year. The total number of visitors to the aquarium during 1934 was 265,604, the receipts amounted to £9,063, which represents an increase of £242 as compared with 1933. The total number of visitors to Whipsnade Park during 1934 was 516,411; the receipts were £22,223, an increase of £3,463 as compared with the previous year.

Books on Agriculture

THE literature devoted to agriculture and allied sciences is now so extensive that the recent issue by the Ministry of Agriculture of Bulletin No 78 entitled "A Selected and Classified List of Books on Agriculture" (6d net) will be very widely welcomed. The books listed, together with many others, English and foreign, and many sets of periodicals, pamphlets and bulletins of agricultural experiment stations from all parts of the world, may be freely consulted in the Ministry's Library at 10 Whitehall Place, S W 1, between the hours of 10 a m and 5 p m (Saturdays, 9 30 a m and 12 30 p m)

Announcements

WE regret to announce the death on January 16, at the age of seventy nine years, caused by an accident while crossing a road in London, of Dr F A. Dixey, F R S , formerly subwarden, bursar and lecturer of Wadham College, Oxford, and president of the Entomological Society in 1909–10

ON February 5, Brigadier M N MacLeod becomes director-general of the Ordnance Survey Department, Southampton, in succession to Brigadier H St J L Winterbotham, who has held the post since August, 1930

PROF E V. APPLETON, Wheatstone professor of physics in King's College, London, has been elected a corresponding member of the Prussian Academy of Sciences (Physico-Mathematical Class)

PROF OTHENIO ABEL, lately professor of palæontology and palæobiology in the University of Vienna, has been appointed ordinary professor of geology and palæontology in the University of Göttingen, and director of the Geological and Palæontological Institute and Museum of the University.

THE Progress Medal of the Royal Photographic Society of Great Britain has been awarded to Mr Harold Dennis Taylor in recognition of his inventions, researches and publications in optical science, which have resulted in important advances in the construction of photographic lenses and in the development of photography

THE Council of the Institution of Naval Architects has awarded the gold medal for the year 1934 to Vice-Admiral Y Hiraga, professor of naval architecture and applied mechanics in the University of Tokyo, for his paper "Experimental Investigations on the Resistance of Long Planks and Ships", and the premium to Prof B. P Haigh, of the Royal Naval College, Greenwich, for his paper, "Further Tests and Result of Experiments on Electrically Welded Joints in Ship Construction". The medal and premium will be presented at the opening of the annual general meetings on Wednesday, April 10, at the Royal Society of Arts, John Street, London, W C 2

AT a reception given at the Collège de France on January 6, to the Assemblée de Médecine générale, addresses in memory of Claude Bernard, who made physiology the foundation of medicine, were delivered by Profs Mayer and D'Arsonval A visit was afterwards paid to Claude Bernard's laboratory in the Collège de France, where his table, instruments, early writings and manuscripts of his works are preserved

AT the annual general meeting of the Royal Meteorological Society held on January 16 the following officers were elected *President*, Lieut -Col Ernest Gold , *Vice Presidents*, Prof David Brunt, Dr A Crichton Mitchell, Dr F J W Whipple and Mr W M Witchell; *Treasurer*, Mr R A Watson Watt , *Secretaries*, Dr John Glasspoole, Mr Eric Ludlow Hawke, Mr M McCallum Fairgrieve; *Foreign Secretary*, Mr Charles J P Cave , *New Members of Council*, Mr E G Bilham, Mrs Charles J. P Cave, Mr C S Durst, Sir Gilbert Walker.

AT the meeting of the Royal Microscopical Society on January 16, the following officers were elected *President*, Prof W A. F Balfour-Browne , *Vice-Presidents*, Mr J E Barnard, Mr Conrad Beck, Mr D M Blair, Dr R S Clay , *Hon Treasurer*, Mr C F Hill , *Hon Secretaries*, Prof R T Hewlett, Mr J Smiles , *New Members of Council*, Mr M T Denne, Dr G M Findlay, Dr E. E Jolley, Mr. J Milton Offord , *Hon Editor*, Dr G M Findlay , *Hon Librarian*, Dr. Clarence Tierney , *Hon Curator of Instruments*, Mr W E Watson Baker , *Joint Hon Curators of Slides*, Mr. N I Hendey, Mr E J Sheppard

THE Jenner Memorial Medal for 1934 has been awarded to Sir George Buchanan, vice-president of the League of Nations Health Committee and Master of the Society of Apothecaries of London, 1934–35 The Jenner Memorial Medal was founded by the Epidemiological Society (now merged in the Royal Society of Medicine as the Section of Epidemiology and State Medicine) in "recognition of the greatest medical service ever done to man", in 1896 on the occasion of the Jenner centenary It is awarded by the Council of the Royal Society of Medicine on the recommendation of the Section for distinguished work in epidemiological research or for pre-eminence in the prevention and control of epidemic disease.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned ·—An agricultural organiser for the Wiltshire County Council—The Clerk, County Offices, Trowbridge (Jan 31). An assistant for research on bonding materials in foundry sands in the British Cast Iron Research Association—The Director, 21 St. Paul's Square, Birmingham, 3 (Feb 8). A senior lecturer in physics, two lecturers in mechanical engineering, an instructor in workshop practice and drawing, and an instructor in carpentry, building construction and geometry at the Lester School and Institute, Shanghai—The Lester Trust, Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (Feb. 25).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 153.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Artificial Radioactivity Produced by Neutrons

IN the course of recent work in radium beam therapy research, we had the opportunity of making investigations in artificial radioactivity induced in some of the heavier elements through the agency of neutrons.

We had available a tube containing 500 mgm. of radium mixed with 2 gm. of finely divided beryllium. This source, and the element to be made radioactive, were immersed in a water bath to obtain the intensification of activity reported by Fermi and his co-workers, and interpreted by them as being due to neutrons slowed up by impact with the hydrogen nuclei of the water. The strong source used, and this method of obtaining intensification, permitted us to measure half lives with fair accuracy in the case of elements previously reported weakly active. The following results were obtained:

Molybdenum	(1)	25 minutes
	(2)	Roughly 36 hours
Palladium	(1)	14 hours
Tantalum		Very slight activity after exposure for 24 hours
Tungsten	(1)	23 hours
Platinum	(1)	36 minutes

The distribution of slow neutrons around the 500 mgm. source immersed in 60 litres of water was studied by measuring the activity excited in a silver tube. Between 5 cm. and 10 cm. from the source, the activity fell off as the inverse first power of the distance, while between 15 cm. and 30 cm. the activity fell off roughly as the inverse fourth power. The edge of the water bath was about 30 cm. from the neutron source. This may account for the rapid falling off observed at the greater distance. The slowed up neutrons could not be detected 2 seconds after the source was removed.

We also had available three small tubes each containing 100 mgm. of radium. In one there was 100 mgm. of beryllium; in a second 100 mgm. of boron; and in the third 100 mgm. of aluminium. In each case the metal was finely divided, and was intimately mixed with the radium associated with it. The radioactivity produced in iodine by each of the three tubes was compared, with the following results:

	Neutron source	Activity excited in iodine (relative)
Tube 1	Radium and beryllium	13·0
Tube 2	Radium and boron	4·5
Tube 3	Radium and aluminium	1·0

The activity produced in a silicon tube by the smaller radium and beryllium source was measured under similar conditions in air and in water. The water reduced the activity by a factor 0·6, in contrast to its effect with silver, when a great increase in activity occurred. The thickness of water between the neutron tube and the concentric silicon tube was 1·4 cm.

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A Spectroscopic Method for Detecting some Forms of Chelation

ABNORMALLY large differences in solubility and volatility between isomers of some disubstituted benzene derivatives have been explained by Dr. N. V. Sidgwick as arising from the presence of chelate rings in the anomalous compounds. These rings are considered to be formed between ortho substituents and usually to contain six atoms, one of which is hydrogen situated between two oxygen atoms. The ease with which such rings can be ruptured has prevented a demonstration of the phenomenon by the usual methods of organic chemistry. In the course of a quantitative study of the infra-red absorption coefficients of a series of organic molecules, which is in progress in this laboratory[1], an apparently specific behaviour has been found for this type of chelated compound.

Organic molecules containing OH, NH, SH or CH show, in the near infra-red, absorption which is characteristic of the presence of these groups. Two illustrative spectrographic records of absorption due to the presence of OH, NH and CH are contained (on p. 3575) in the first report[1] of the above mentioned research. In these studies, on which a second report is now being prepared for publication, it has been found that the absorption (area under the absorption coefficient against frequency curve) in the vicinity of $1\cdot4$–$1\cdot6\,\mu$ due to one NH or to one OH group, shows variations which are not very large even among molecules of widely different types. These variations are, however, by no means negligible. Actually the difference in area so far observed is such that the largest is less than three times the smallest. Since, however, in most cases an absorption of one fiftieth of the mean value could be detected with reasonable certainty, this characteristic absorption can probably be used with confidence in detecting the presence or absence of these groups in organic molecules. This forms the basis of the method here proposed for detecting some forms of chelation, the absence of such OH absorption in molecules showing OH by ordinary chemical tests being taken as indicating chelation through hydrogen. The variations in the area under the absorption curve constitute one of the quantitative differentiating factors which have been developed in the above mentioned research in an attempt to build an analytical method. Variations occur also within any one group such as OH or NH in the position of the absorption, as well as in the shape of the absorption curve, the latter being particularly striking. In those of the compounds discussed below which show OH absorption, pronounced variations in all three of these factors occur, and they may all be important in the matter of chelation, but their significance requires further study for its interpretation.

Particular examples of compounds that have been examined in the above manner and found to give no absorption characteristic of molecules containing

OH are: salicylaldehyde, *o*-nitrophenol and 2, 6-dinitrophenol, which have properties typical of chelated substances[2], methyl salicylate and *o*-hydroxyacetophenone which, although not previously tested, are representative of Prof. Sidgwick's Type B[3], and salicyl-α-methyl-α-phenylhydrazone and γ-diethylaminopropanol While there has been no prior consideration of the last two compounds as chelated, in each of them the condition of a six membered ring is fulfilled, however, with nitrogen replacing oxygen Benzoin and 8-hydroxyquinoline, which form chelated salts[4], give characteristic OH absorption, as also do ethyl lactate and diethyl tartrate These last compounds apparently are doubtful cases of chelation, the first three require five membered rings and in the last one either five or six membered rings are possible

Characteristic OH absorption was found in *p*-hydroxybenzaldehyde, *m*-nitrophenol, *p* hydroxyacetophenone, *o*-chlorophenol, and 2, 4, 6-trichlorophenol, which were selected, from the OH compounds that we have examined, as non chelated compounds comparable to the first five of the above mentioned substances 2, 4, 6 Trichlorophenol is further of interest in that the OH group is so placed as to be 'sterically' affected in reactions It is probable, for physico chemical reasons, that neither these nor the preceding observations have been influenced by association since the solutions are of the order of 0 01 molal

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[1] *J Amer Chem Soc*, **55**, 3574, 1933
[2] *J Chem Soc*, **123**, 2819, 1923
[3] "The Electronic Theory of Valency" (London, 1929), p 240
[4] Ref 3, p 245

Surface-force Theory of Crystal Rectification

EXPERIMENTS with Mr A. K Das-Gupta have shown that when carborundum, zincite or silicon crystal is placed between two mercury electrodes giving a large contact area, there is considerable rectification Similar experiments with symmetrical crystals like iron pyrites, galena, etc, have shown no rectification. These experiments strongly suggest asymmetric conductance in crystals having no centres of symmetry. Accordingly, crystal detectors can be classified thus (1) crystals having centres of symmetry, and (2) crystals having no such symmetry. In the symmetrical crystals, we observe rectification associated with point contacts In the second group, in addition to this 'point'-rectification, there is *volume* rectification, due to asymmetric conductance The object of the present note is to suggest a theory of rectification in the *symmetrical crystals*.

In an ionic crystal (like iron pyrites, galena, etc), if we take a plane where *similar* sets of ions are placed at regular intervals, it is evident, if we consider the first layer and the next, that any ion on the surface has an unbalanced electrostatic force. When an alternating voltage is applied to the surface of a crystal where crystal planes parallel to the surface contain similar sets of ions, this electrostatic force on the surface would give rise to a unidirectional current The crystal plane in the first layer may contain *all* positive or *all* negative ions. Both positive and negative rectification effects are therefore possible. In planes which contain oppositely charged ions *alternately*, the 'whisker' is in contact with a large number of such ions, thus giving, on an average, no rectification This is what is actually observed in natural poly-crystals

Of the two features in the current-voltage characteristic curves, namely, (1) asymmetry and (2) curvature, the first is explained in the symmetrical crystals in terms of the electrostatic force on the surface, the second is due to

(1) local heating at the junction, as pointed out by Eccles[1], and

(2) the effect of strain on the crystal, as explained by Dowsett[2].

A small contact area for the 'point' rectification is necessary, because a large contact area means a large number of small contact points of varying degrees of rectification giving on the average a small effect Besides, for some points, the contact resistance is extremely small, causing more or less a short circuit

The surface-force theory can explain the following experimental results obtained in this laboratory:

(1) Rectification observed in the case of symmetrical crystals in contact with pointed crystals of the same composition (Eccles's thermo-electric theory[3], and Schottky's electronic theory[4], fail to explain these results)

(2) Decrease of rectification on heating the crystal.

(3) Decrease of rectification on heating the junction in the case of symmetrical crystals

(4) Decrease of rectification on exposure to ultra-violet light and X-rays.

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Nov. 5.

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[1] Eccles, *Proc Phys Soc*, **22**, 1914
[2] Dowsett, "Year Book of Wireless Telegraphy, 1922" (See also Dowsett's Wireless Telephony and Broadcasting", Vol 2, Ch ii
[3] Eccles, *Proc Phys Soc*, **25**, 1915
[4] Schottky, *Z Phys*, **4**, 1923

Synthesis of Vitamin C by Luteal Tissue

MOURIQUAND and Schoen have shown[1] that gravid female guinea pigs on a scorbutic diet develop scurvy only very slightly or not at all They considered that the fœtus was capable of synthesising vitamin C, and thus protected the mother from incurring the disease Afterwards, Rohmer, Sanders and Bezssonoff[2] and Rohmer, Bezssonoff and Stoerr[3] showed that the young human infant, up to the age of five months, is capable of synthesising vitamin C.

It appears from these results, therefore, that the fœtus almost certainly synthesises vitamin C in fairly large amounts It is known that the corpus luteum possesses a high concentration of the vitamin in its cells, and the question arises whether presence of the vitamin in this situation is the result of its manufacture by the fœtus, or whether it is the result of the intake of vitamin C in the food.

It was decided to endeavour to create a corpus luteum in an experimental animal with the aid of the luteinising hormone of the anterior pituitary, in order to ascertain whether this would protect the animal from scurvy induced by a scorbutic diet.

The chief difficulty was in the choice of animal.

Rats, mice and rabbits are the most suitable animals on which to use the luteinising hormone, but they possess the ability to synthesise vitamin C to varying degrees The guinea pig, while being an admirable subject for tests in connexion with scurvy, does not readily respond to the luteinising hormone It was found, however, that in guinea pigs, injections of fifty rat units of antuitrin S for three days, while it did not produce a definite corpus luteum, caused considerable luteinisation of groups of cells These cells also possessed the power of reducing silver nitrate.

Three groups of animals were then placed on a scorbutic diet (*a*) pregnant females, (*b*) young virgin females, untreated, (*c*) young virgin females receiving fifty rat units of antuitrin S a day subcutaneously (50 rat units = 0·5 c c antuitrin S) The diet consisted of bran and pollen, olive oil, wheat germ, Radiostoleum, common salts All the animals lost weight on this diet At the end of a fortnight, all the untreated animals had died of typical scurvy—their adrenals giving no reaction with vitamin C

The treated animals, although having lost considerable weight, were active and showed no signs of scurvy, although two had died of an acute infection The pregnant animals appeared much the same as when the experiment started and had lost very little weight

The results of this experiment suggest that the luteal tissue is capable of synthesising vitamin C, it does not disprove the synthesis of vitamin C by the fœtus It is probable that the synthesis takes place first in the corpus luteum and, once the fœtus is developed, it either takes over, or supplements, the vitaminogenic function of the luteal tissue[3]

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Nov 16

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[1] G Mourlquand and J Schoen, *C R Soc Biol*, **187**, 203, 1933

[2] P Rohmer, U Sanders, and N Bezssonoff, NATURE, **134**, 142, July 28, 1934

[3] P Rohmer, N Bezssonoff, and E Stoerr, *Bull de l'Acad de Med*, 871, June 1934

Activation of Cambial Growth

EVIDENCE was recently obtained by one of us[1] indicating that the influence coming down from the leaves, which activates cambial growth, is a hormone Also Laibach[2] has caused decapitated epicotyls of *Vicia Faba* and various leaf-stalks to grow in thickness by placing on them the pollinia of orchids, which he has shown to exude large quantities of auxin, the hormone which promotes the elongation of stems, but he has not stated what anatomical changes were involved We have now been able to activate cambial growth in decapitated strips of young sunflower hypocotyls, by inserting the upper ends of the strips into a 0·02 per cent solution, in 25 per cent gelatine, of the ether-soluble component of urine, which is known to contain abundant auxin[3] The gelatine containing the extract was applied in short pieces of glass tube while warm and liquid, and quickly set to a gel It contained a little thymol (1 in 100,000), and was renewed every three days.

After 19 days, the parts covered by the gelatine had all formed cambia, which were in the normal positions and had grown very strongly, one of them having formed more than twelve layers of secondary xylem These parts had also, quite unexpectedly, formed numerous roots A few millimetres below the gelatine, also, there had been distinct cambial growth, though at this level it was very much less In controls, gelatine and thymol without the extract did not cause any cambium or roots to be formed The results raise the question whether, in spite of some indications to the contrary[1,4], the hormone activating cambial growth is the same as auxin The experiments will be continued

We are much indebted to Dr Weisberger, of the organic chemistry laboratory, Oxford, for kindly showing us how to extract the ether-soluble component by the method of Kogl and collaborators[3]

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B LE FANU

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[1] Snow R, *New Phyt*, **32** 288, 1933

[2] Laibach, F, *Ber Deutsch bot Ges*, **51**, 336 1933

[3] Kögl, F Haagen Smit, A J and Erxleben H *Z physiol Chem*, 214, 241, 1933

[4] Snow R, *New Phyt* **31** 451 1932

Recession of the Spiral Nebulæ

THE very recent and inspiring work of Prof E A Milne on world structure has led us to investigate whether there exists a law connecting the velocity and distance of a particle from an observer which is invariant for the generalised Lorentz transformation In the usual notation, the only law of the form $f(x_1, x_2, x_3, x_4) = 0$ which is invariant for the infinitesimal Lorentz transformation is known to be $x_1^2 + x^2 + x_3^2 + x_4^2 = 0$, which gives the propagation of light Following this, we have investigated whether there exists a law of the form $\varphi(x_1, x_2, x_3, x_4, u, v, w) = 0$ which is invariant for the generalised Lorentz transformation, here $u = dx_1/dx_4$, $v = dx_2/dx_4$, etc In its generalised form the transformation is

$$\begin{aligned} x_1' &= x_1 + (hx_1 + ax_2 + bx_3 + cx_4) \\ x_2' &= x_2 + (-ax_1 + hx_2 + dx_3 + ex_4) \\ x_3' &= x_3 + (-bx_1 - dx_2 + hx_3 + fx_4) \\ x_4' &= x_4 + (-cx_1 - ex_2 - fx_3 + hx_4), \end{aligned}$$

$$\text{and } u' = \frac{u + (hu + av + bw + c)}{1 + (h - cu - ev - fw)},$$

similarly, v', w' may be obtained h, a, b are the constants of the transformation We have found that the following set of equations is the only invariant set of this type, that is, involving both velocities and co-ordinates

$$\frac{u}{x_1} = \frac{v}{x_2} = \frac{w}{x_3} = \frac{1}{x_4} \qquad (1)$$

The corresponding equations for u', v', w' follow immediately from (1)

The importance of (1) may be judged from the fact that, next to the equation of light, the most fundamental relation hinged upon the Lorentz transformation is the distance-velocity relation (1), which has been expressed by Milne in the form $v = r/t$.

It is natural to expect that a relation of this nature should hold good only in the outer regions of space where the island universes are too far removed from each other to cause any appreciable departure from this law It is, at any rate, unreasonable to expect the law to hold good in the central galaxy itself because of the powerful gravitational field in it

V V. NARLIKAR

Hindu University,
Benares
Dec 17

THE recession law, $v = r/t$ in combination with the density-distribution law $n\,dx\,dy\,dz = Bt\,dx\,dy\,dz/(t^2 - r^2/c^2)^2$, can be shown to be a valid description of a certain system of particles in motion on *any* relativistic law of gravitation This was the subject of my lecture to the London Mathematical Society, "World Gravitation by Kinematic Methods", delivered on May 17 last (see NATURE, May 26, 1934, p. 789) A full discussion of this subject is given by me in a volume now passing through the press

E A MILNE

Rotational Raman Effect in Gases: Carbon Dioxide and Nitrous Oxide

IN the course of a detailed investigation of the rotational Raman effect in gases, we have obtained the following significant results with carbon dioxide and nitrous oxide In Fig 1 are shown photomicrometric records of the rotational wings obtained with carbon dioxide gas at pressures of about 6 and 50 atmospheres respectively The exposure times are so adjusted that the intensity of the wing is nearly the same in both cases It may be noticed that in the low pressure record, the wing exhibits distinctly a position of maximum intensity, shown by the arrow, and then fades off until it merges into the Rayleigh line

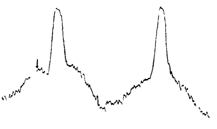

FIG 1 Photomicrometric records of the rotational wings with carbon dioxide at pressures of 6 atmospheres (left) and 50 atmospheres (right)

A quantitative investigation reveals that both the position of the intensity maximum and the distribution of intensity within the wing are in good agreement with theory On the other hand, in the high pressure record, no such maximum is visible and the wing is relatively more intense in the region lying between the position of the maximum and the Rayleigh line It is of significance that these features which are characteristic of liquids[1] make their appearance also in gaseous carbon dioxide, but only at the higher pressure Exactly similar results are obtained by us with nitrous oxide working at 6 and 40 atmospheres respectively. Such phenomena are evidently connected with the fact that, at the higher pressures, the gases investigated are very near their critical states, thus resembling the liquids in certain respects.

It may be of interest to note here that our measurements of the intensity maxima at low pressures give 69×10^{-40} and 62×10^{-40} respectively for the moments of inertia of CO_2 and N_2O molecules, as against $70{\cdot}1 \times 10^{-40}$ and $59{\cdot}4 \times 10^{-40}$ deduced earlier from infra-red absorption[2].

S BHAGAVANTAM
A VEERABHADRA RAO.

Physics Department,
Andhra University,
Waltair
Nov 8

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[1] *Ind J Phys*, 8, 437, 1934

[2] Adel and Dennison, *Phys Rev*, **44**, 99, 1933 Plyler and Barker, *Phys Rev*, **38**, 1827, 1931

Development of the Lightning Discharge

SOME months ago, B F. J. Schonland and H Collens[1] published several important photographs of lightning discharges taken by a Boys' camera, that is, two lenses fixed at opposite points of a circle and revolving rapidly about its centre In a further communication, with D F Malan, published in NATURE[2], a brief account is given of some further results with their camera The most important point which emerges from a consideration of their new photographs is that there is a characteristic difference between the predischarges of the first stroke of a lightning flash and those of the subsequent strokes of the flash along the same track. While the latter predischarges are of a continuously moving character and travel from cloud to ground generally in less than 1/1,000 of a second, the former move from the cloud in a discontinuous step by step manner and take a comparatively long time to reach the ground, sometimes more than 1/100 of a second

I would remark here that this manner of the first development of the track of an electric discharge through normal air was shown by me for the laboratory spark so long ago as 1898[3] and for the lightning discharge in 1902[4], in both cases using moving photographic plates to analyse the discharges

B WALTER.

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[1] *Proc Roy Soc*, A, **143**, 654, 1934

[2] NATURE, **134**, 177, Aug 4, 1934

[3] *Ann Phys und Chem*, **66**, 636, 1898 **68**, 776, 1899

[4] *Ann Phys*, **10**, 393, 1903 A more detailed account appeared in *Jahrbuch d Hamburg wiss Anstalten*, **20**, 1903

Moulting and Replacement of Feathers

IN a recent publication, Dr. Lowe[1] has described the peculiar moulting of penguins as due to new feathers pushing out their predecessors in rather widespread areas, and regards this as a unique feature of Sphenisciformes Moulting in patches is certainly a rare occurrence under normal conditions in the majority of birds, but a new feather growing at the base of the old feather is the usual method of replacement during the moulting period. Dr. Lowe further says: "the intrusion of the tip of the new feather through the lower umbilicus of the old is interesting, because in birds in general as soon as the growth of the feather becomes an accomplished fact the lower umbilicus at the base of the calamus is definitely sealed, making the entry of a new feather an impossibility". He continues by using this as one of the reasons for regarding the penguin as primitive rather than degenerate, and quotes Gadow that the only known exception to this general rule is in *Struthiones*, where the old feather is carried for some time at the tip of the new

Although statements have recently been made (Lillie and Juhn[2]) saying that it is not yet known whether the pulp of a feather resumes activity prior to shedding of the old feather, it is a well-known fact (Lynds Jones[3], Cossar Ewart[4] and others) that in young chicks and ducklings, the first generation feather is carried for some time at the tip of the succeeding definitive feather Again, in adult fowls and ducks, if feathers are plucked near the moulting period, the new feather is invariably pulled away attached to its predecessor This is unavoidable owing to the method of formation of the new feather. In nestling down, there is definite continuity between barbs of the new feather and the calamus of the old one, and in addition, the developing barbs are so constricted within the calamus of the old feather, that they usually show a distinct curve distally for some time after the old feather has been shed

In definitive feathers, the new feather is always formed within the base of the old (except, of course, during regeneration following deliberate plucking) This is due (*a*) to the outermost intermediate cells of the 'collar' cornifying to form the base of the calamus, instead of the whole of the stratum intermedium cornifying *en masse*, as it does more distally, while (*b*) the median layers form a second sheath within the calamus, and (*c*) the innermost layers form the ridges from which the barbs of the new feather arise This process is described in detail in a paper now in press

From this method of replacement of a feather, the lower umbilicus could not be completely sealed when the feather is fully grown It is true that feather caps form as the pulp withdraws when the feather is nearing maturity, but these do not extend to the actual base A minute papilla projects within the inferior umbilicus while the feather is attached to the bird, limited in its extension by the last feather cap, and it is from this papilla that the new feather grows If the old feather is plucked when fully mature, but before the new feather has commenced to form, then this remnant of the previously extensive pulp is left behind in the follicle, so that the impression of an entirely pulpless and sealed feather is obtained.

It is therefore clear that these facts of the inferior umbilicus of the feather remaining unsealed, and the new feather pushing out the old, cannot be regarded as peculiar to Sphenisciformes or to Struthioniformes

ANNE HOSKER

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Dec. 5

[1] *Proc Zool Soc*, 483–538, 1933
[2] *Phys Zool*, V, 124–184, 1932
[3] *Lab Bull*, No 13, Oberlin College, 1907
[4] *Proc Zool Soc*, 609–642, 1921

Occurrence of *Limnocnida* in the Periyar Lake, Travancore

ON June 4 last, I was surprised to find a number of fresh-water medusæ in the Periyar Lake in Travancore From the shape of the manubrium and the presence of the gonads on the manubrium, and the shape and the arrangement of the nematocysts, the medusæ undoubtedly belong to the genus *Limnocnida* which has previously been recorded from India. The Periyar Lake, about ten square miles in extent, has been formed by damming at its source in the Western Ghats the River Periyar, which flows westwards. Although the river fluctuates with the seasons, the lake contains deep water all the year round It is noteworthy that fresh-water medusæ were found by Mr. S P Agharkar, but were in a river system which flows eastwards across the continent and enters the Bay of Bengal

The Periyar Lake is situated at an elevation of three to four thousand feet and is sixty miles from the west coast of India as the crow flies All the medusæ I saw were about the same size and very much smaller than those discovered by Mr Agharkar Mr Agharkar's specimens measured 1·75 mm when young, 15 mm when adult The smallest of my specimens, however, measures 4 2 mm in diameter and the largest 4·9 mm in diameter and 2 2 mm in height, with tentacles measuring 1 6 mm So far, they have received only a cursory examination

I believe the occurrence of *Limnocnida* has only been recorded from one area in India previously, that is, in the headwaters of the Kistna River and the neighbourhood, 650 miles from Periyar Whether the species inhabiting the Periyar Lake is the same as that described by Dr Annandale or a new species can only be determined after a proper examination of the collection

PHYLLIS SEYMOUR DARLING

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Dec 13

Local Variation in Habits of the Lizard, *Amblyrhyncus cristatus*

ON a recent visit to the Galapagos Archipelago I noticed a point concerning *Amblyrhyncus cristatus*, an aquatic species, which might be of interest as a footnote to Darwin's observations on the same reptile

In "The Voyage of the *Beagle*", Darwin says "I several times caught this same lizard, by driving it down to a point, and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water, and as often as I threw it in, it returned in the manner above described".

I tried this same experiment myself on Albemarle Island, and found the reptile returned to dry land at great speed, but on Indefatigable Island, on the contrary, the lizards not only held no prejudice against entering the water, but even proceeded to do so as quickly as possible on being approached—a curious example of local variation

Darwin attributes their reluctance to enter the water to the presence of sharks, but it is singular that I found sharks more numerous around Indefatigable Island than elsewhere in this archipelago.

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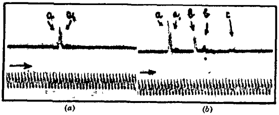
Dec 26.

Simultaneous Travel of a Surge of Stress and a Group of High-Frequency Waves of Stress in a Steel Wire

IN previous communications, it has been shown how the frequency of longitudinal vibration of a steel wire may be measured[1] and also how the speed of travel of a surge of stress in a steel wire may be measured directly[2]. From each of these methods the value of Young's modulus may be found, and the values so obtained are in close agreement with each other and with the value obtained by the static method.

Experiments have recently been made in which a surge of stress and a group of high-frequency waves of stress were caused to travel simultaneously along a steel wire For this purpose, a hard drawn steel wire as used in colliery winding ropes was obtained of a total length of about 500 ft and diameter 0 123 in. The wire was firmly clamped near one end by means of three clamps spaced about 18 in. apart About 50 ft. from this end the wire passed through a solenoid and search coil, and a second exactly similar solenoid and search coil was arranged at a distance of 268 3 ft along the wire from the first solenoid, the free length of wire beyond the second solenoid being 185 7 ft The solenoids were connected in series and excited by direct current The two search coils could be connected in series through a valve amplifier to the oscillograph or each coil could be used alone when so desired A 500 frequency standard tuning fork was used to provide the timing wave



(a) (b)

FIG 1

In the first test, the search coil of No 1 solenoid was used alone When the wire was struck at the clamped end the oscillogram shown in Fig 1*a* was obtained It will be seen that a group of high-frequency waves is superposed at a_1 on the surge a, this group being due to the longitudinal vibration of the clamped sections of the wire There are also smaller groups of waves which pass through the solenoid later, but after about 0 016 sec no further disturbances pass In Fig 1*b* is shown the oscillogram which was obtained when the two search coils were connected in series and a blow was struck at the clamped end of the wire It is now seen that the group of high-frequency waves again appear at a_1 superposed on the surge at a. When, however, the disturbance has reached the second search coil, the surge and the group of waves have become widely separated as shown at $b\,b$, so that the group is travelling at a much lower speed than the surge The peaks at c are due to the reflexion of the surge at the distant end of the wire returning through the second solenoid

It is not clear why the group of waves should travel at a speed so much slower than the surge Experiments with an annealed wire indicate that the speed of the group is more nearly equal to that of the surge Further experiments are being made to observe the effects on this phenomenon of the frequency of the waves in the group

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Nov. 30.

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[1] NATURE, 132, 351, 1933.
[2] NATURE, 133, 418, 1934

Accuracy of the Curie-Chéneveau Magnetic Balance

IN a letter to NATURE[1] and also in a recent Royal Society paper[2], F E Hoare mentions difficulties that he has had with the Curie-Chéneveau magnetic balance and states that after a trial of some months he has decided to abandon the use of this instrument He concludes that it is "almost impossible" to place the specimen always in exactly the same position in the field and he thinks that he can thus explain "the unaccountable changes in the deflexion for water obtained from time to time" by Gray and Dakers[3] and described by them in the words just quoted These unaccountable variations, however, are in many cases observed even when the tube has not been removed from the beam between readings, and in any event do not exceed 1 per cent, whether the question of position is involved or not Instead of the 20 per cent of Hoare, the variations observed in this Department are thus of a much smaller order, even with the balance in its crudest form, and probably are due to a different cause The instrument is free even from this small irregularity in its normal working condition. Both the steadiness attainable and the ease with which the position can be adjusted, with reasonable care, are indicated by the latest measurement made in this department by one of us (J H C)

Deflexions were read for four separate fillings with water and four separate fillings with ethyl nitrate It was impossible to detect the slightest difference between the four water readings each was 16 00 ± 0 01 cm for tube + water Similarly, the four readings for tube + ethyl nitrate were identical, namely, 12 30 ± 0 01 cm, in every case, with not the slightest variation The eight measurements were done in 2½ hours

Hoare directs attention to the discrepancies between the results of Gray and Dakers[3] for rubidium bromide and those of Ikenmeyer[4], although from his recent paper[2], when he compares his own results with those of Ikenmeyer, he has a rather poor opinion of the latter as standards for comparison Gray and Dakers' results are supported, however, by Pascal[5], the sum of whose atomic values, 57 8, is much closer to the 56 69 ± 0 54 of Gray and Dakers[3] than to the 65 5 of Ikenmeyer (quoted by Hoare) or to the 62 9 of N Crow[6] Pascal adopted non torsional methods, and to compute his atomic values utilised at least nine substances

The usefulness of this instrument, however, does not depend upon a few isolated instances Numerous results of high precision have been obtained, and confidence in these results is further strengthened by the adaptability of the data to interpretation There must be reserved for a future communication a fuller account of results achieved with the balance and also a description of improvements in the apparatus and in the details of its manipulation It is hoped, in this way, to put our experience at the disposal of those prepared to give the instrument a trial

FRANCIS W GRAY
JAMES H CRUICKSHANK.

Department of Chemistry,
University, Aberdeen.
Dec. 13.

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[1] F E Hoare, NATURE, 132, 514, 1933
[2] F E Hoare, *Proc Roy Soc*, A, 147, 88; 1934
[3] Gray and Dakers, *Phil Mag*, 11, 81, 1931
[4] Ikenmeyer, *Ann Phys*, 1, 169, 1929
[5] P Pascal, *C R*, 158, 37, 1914
[6] N Crow, *Trans Roy Soc Canada*, 19, 63, 1925. NATURE, 117, 449, 1926

Disintegration by Slow Neutrons

CHADWICK and Goldhaber, in their letter to NATURE on January 12, record experiments which indicate that slow neutrons can eject heavy charged particles from light atoms, even when the neutron traverses the atom "at relatively large distances" from the nucleus To account for this, they suggest that there may be an attractive force between a nucleus and a neutron, at these large distances

An alternative explanation is that the heavy particles are not in the nucleus, but outside it

JOHN TUTIN

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Jan 14

Velocity of Sound in Liquid Oxygen

IT seems that the velocity of sound has never been measured in liquefied gases at low temperatures, probably because the customary methods were not easily practicable It appeared reasonable to try as a new method the effect, which has recently been discovered by Debye-Sears and Lucas-Biquard, namely, the scattering of light by ultrasonic waves in liquids and solids Judging from the results which I have obtained using oxygen as a scattering liquid, this method provides indeed a simple and convenient means for this purpose The experiments, which were carried out with oxygen of 99 3 per cent purity, boiling at atmospheric pressure (705–720 mm mercury) at 183 6° C, and with a frequency of 7,500 kilocycles, yielded a sound velocity of 903 m /sec Taking 1 140 as the density of the liquid, one gets then an adiabatic compressibility of 105 6 × 10^{-6} cm ^{2}/kgm The isothermal compressibility may also be calculated, with 3 38 × 10^{-3} as the value of the differential of the specific volume, and 0 406 as the specific heat at constant pressure, it comes out as 172 0 × 10^{-6} cm ^{2}/kgm

A detailed account will appear in *Helv Phys Acta*

R BAR

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Dec 27

Points from Foregoing Letters

BY means of a powerful source of neutrons (half a gram of radium mixed with beryllium) Prof J C McLennan, Mr L G Grimmett and Mr J Read have produced *measurable radioactivity in the* elements molybdenum, palladium, tantalum, tungsten and platinum *They have determined* with fair accuracy the radioactive life-periods thus induced in these elements

The amount of absorption of infra red light (1 4–1 6μ) by certain organic substances can be related to their molecular structure as deduced from chemical tests, solubility, volatility, etc Dr. Hilbert and Messrs Wulf, Hendricks and Liddel state that when a hydrogen atom of an organic molecule is joined to two oxygen atoms by a co-ordinate link (*that is, it forms a 'chelate' ring by sharing two* electrons of one of the oxygens) then the compound does not show the usual amount of infra-red absorption typical of ordinary compounds containing the OH group, although by chemical tests the OH group appears to be present

Crystals without a centre of symmetry (carborundum, zincite) when placed between two mercury electrodes, can be used as radio-detectors, while symmetrical crystals (galena, pyrites) do not give rectification with such large contact areas, but only with point contacts (cat's-whisker). Dr S R Khastgir outlines a theory based upon the arrangement and the unbalanced electrostatic forces of the atoms in the surface layers of the crystals, and claims that this theory explains a number of observations not accounted for by other views of crystal rectification

It has been shown that infants can produce their own vitamin C. From experiments with female guinea pigs in which luteal tissue was artificially induced, Dr. Geoffrey Bourne deduces that the corpus luteum of the ovary also has the ability to synthesise the anti-scorbutic vitamin C.

Mr. R. Snow and Mr. B. Le Fanu find that the cambium cells from strips of decapitated young sunflower plants, not only continue to grow, but even produce wood cells (xylem) and give off roots, when covered with *gelatin containing* auxin (from the ether-soluble extract of urine) This raises the *question whether the hormone activating cambial* growth may not be identical with auxin, which has *been shown to promote cell elongation and root* formation

Prof V V Narlikar gives an equation, which he states to be the only one, relating space time *and velocity* in such a way that the formula is invariant (independent of the observer's motion) From this formula the recession of spiral nebulæ can be deduced

The distribution of intensity in the spectrum of the light scattered by gases at different pressures has been determined by Mr S Bhagavantam and Mr A. V. Rao They find that the 'wings' of continuous light, which appear at the sides of the primary line and have been ascribed to the rotation of molecules, become similar to those obtained with liquids, when the gases are under high pressure

The replacement of feathers in fowls is described by Miss Anne Hosker, who points out that not only in penguins and ostriches, as mentioned by Dr Lowe, but also with young chicken and ducklings, the first feathers during moulting are carried for some time at the tips of succeeding ones

Dr. T F. Wall reports that in a hard-drawn steel wire, with one end clamped by three clamps 18 in apart, a group of high-frequency waves of stress (produced by a blow at the clamped end) was found to travel along the wire more slowly than the simultaneous surge of stress In an annealed wire, the speed of the group of waves is more nearly equal to that of the surge

Dr. F W Gray and Mr J. H Cruickshank defend the accuracy of the Curie-Chéneveau magnetic torsion balance, they do not agree with F E Hoare that the unexplained variations observed at times by Gray and Dakers with water are due to the unreliability of the balance.

Research Items

Origins of Morris Dance. The question of the origins of the Morris dance and of its name is once more raised by Mr. Rodney Gallop (*J. English Folk-dance and Song Soc.*, **1**, No. 3). The belief generally held that 'Morris' was a corruption of 'Morisco' and the dance itself of Moorish origin was doubted so long ago as the time of Strutt, who in his "Sports and Pastimes of the People of England" suggested that it was derived from a part of the ceremony of the Feast of Fools; but Francis Douce in 1839 tried to justify the traditional view, while recognising that the European Morris differed widely from the true Moorish dances. Cecil Sharp at first (1906) adopted Douce's view, but later (1912) held that it was a development of a pan-European, or even more widely, distributed custom. He held, however, that the name might still be derived from 'Morisco', but without any implication of origin. It was a popular 'explanation' of the blackened faces of the dancers. It is now pointed out that 'Morisco' is applied to a wide diversity of dances, first appearing in the fifteenth century in France, Burgundy and Italy. In England, from the sixteenth century onward, it is both a court dance and a folk-dance. No single feature is common to all, the two widespread elements, the blackening of the face and the use of bells, to which attention mainly has been directed, being by no means universal. In numerous ceremonial combats, the opponents are 'Christians' and 'Moors'. These combats were of wide distribution and still survive in Portugal and on the east side of the Adriatic, and they have been carried to Panama and Mexico. The Morisco of the Hispanic peninsula does not always involve two sides and a combat. Some are purely processional, though in origin obviously a survival of the pagan ceremonial combat. One side has tended to disappear, and the survivors have retained the name of 'Moor', possibly as the equivalent of 'pagan' and as applied to a 'pagan' dance.

New Fishes from New Jersey and Florida. Mr. Henry W. Fowler in his paper "The Buckler Dory and Descriptions of three New Fishes from off New Jersey and Florida" (*Proc. Acad. Nat. Sci. Philadelphia*, **86**, 1934) describes an interesting new species of *Macrorhamphosus*, *M. otteri* which has before been confused with the Mediterranean *M. scolopax*, but differs from it in the more advanced spinous dorsal origin and consequently longer interdorsal area, and in its deeper body. *Parathunnus rosengarteni* n. sp. is also described from a mounted specimen angled by Dr. Rosengarten in Florida waters, and recognised by him as a species distinct from any with which he was acquainted. This fish has a lateral golden band running along the whole length from eye to tail and measures 713 mm. Another interesting new species is *Antigonia browni*, the depth of which is 1/5 greater than its length; it differs in many ways from its Barbados relative *Antigonia capros*, Lowe, the only other American species known. The specimens of the Buckler dory, *Zenopsis conchifer*, establish its distribution over the western Atlantic, known from there previously only from the imperfect and immature *Zeus ocellata*, and indicate that it is likely to occur all along the region of the Gulf Stream.

Culture of the Mantle-Wall of *Helix*. J. Brontë Gatenby, Joyce C. Hill and T. J. Macdougald (*Quart. J. Micro. Sci.*, **77**, Pt. 1, 1934) give an account of the technique of the culture of small pieces of the mantle-wall of *Helix aspersa*, more particularly to obtain aseptic growths. In such cultures the amœbocytes wander out of the piece of tissue and become much flattened, but do not form a connective tissue network to such a degree as in non-aseptic culture. In older explants, the Golgi apparatus of the amœbocytes breaks up into granules which become scattered through the cells; hence statements concerning the Golgi apparatus, based on evidence obtained from cells in culture, are of doubtful value. There is good evidence that the cells in the tissue cultures of *Helix* divide by amitosis. The amœbocytes do not ingest bacteria until the latter have become very numerous. Joyce C. Hill contributes (*J. Roy. Micro. Soc.*, **54**, No. 3, 1934) a useful article on the technique of the culture of the tissue of *Helix*. The Hédon-Fleig saline solution, the composition of which is stated, proved to be the most satisfactory, for in this the amœbocytes which emigrated from the mantle wall produced a well-organised connective tissue network. By sterilising pieces of tissue, either by exposure to ultra-violet radiation or by soaking in blood, the life of the cultures was much prolonged. The amœbocytes were more flattened and did not unite to form a definite network.

Iodised Wraps for Fruit Storage. Mr. R. G. Tomkins, of the Low Temperature Research Station, Cambridge, has investigated the possibilities of using iodised coverings for fruit when placed in storage. The severity of many fungal diseases of storage is notorious, and the use of germicidal covers would appear to be one of the most obvious methods of control, if the fungicide has no harmful effect on the fruit. Initial difficulties seem to have been largely overcome (*J. Pomol. and Hort. Sci.*, **12**, No. 4, pp. 311–320, December, 1934). The iodised wraps are made by treating tissue paper with a definite volume of iodine solution—a covering 25 cm. square contains approximately 30 mgm. of free iodine. Laboratory tests show that storage rots of fruit can be considerably reduced by this kind of wrapping, whilst the appearance and ripening of most varieties is not impaired. Problems for the future include a study of the amounts of iodine absorbed by the fruit, and a more extensive determination of varieties which are harmed by iodine treatment.

Cyclones in Mauritius. The cyclone season of 1932–33 in Mauritius and in the neighbouring parts of the South Indian Ocean is described by N. R. McCurdy, director of the Royal Alfred Observatory, Mauritius, in Miscellaneous Publication No. 15 of that observatory. This is the sixth of a series of publications dealing exclusively with the cyclone seasons of that region. For this year the amount of data available for drawing synoptic charts is greater than at any time previously. There were six cyclones in this season, a smaller number than usual, and fortunately only one of these appears to have been intense. The storm in question appeared on the synoptic charts for March 3–15, 1933, and passed between Mauritius and Madagascar; it followed a very unusual course, twice approaching Madagascar from the north-east and recurving to the south-east. Several ships were involved in the region around the centre, where winds of hurricane force were encountered with very heavy rain and extremely high seas, and one ship was unfortunate enough to spend some days near the centre, having waited for the storm to pass away to the south-east after the first recurve and being involved in the second recurve, when the rate of travel of the centre was only two miles an hour. Another interesting phenomenon was noted in connexion with two storms in February 1933. These formed within a few days of one another and both appeared on the synoptic charts for several successive days. This is regarded as a common occurrence in this region, for three similar cases were described in Miscellaneous Publication No. 14, which describes the cyclone season of 1931–32. One of the remaining cyclones provides an example of the partial break up of a storm on its encountering the high ground in Madagascar. The author of these papers concludes that cyclones do not disturb the winds of the cirrus level at Mauritius when their centres are more than two or three hundred miles away.

Heating of Electric Cables exposed to the Sun. The maximum current an electric cable can carry is fixed by the temperature rise of the cable after the current has been flowing so long that the cable has attained a constant temperature. It is usual to specify a temperature rise of 50° C. above that of the surrounding air. If the cable is exposed to direct sunlight a substantial increase of temperature will occur, and this will increase the resistance of the cable and consequently the electric power lost in it. The British Electrical Research Association has prepared a report on this subject (*J. Inst. Elec. Eng.*, Dec. 1934). The maximum solar radiation in different parts of the world is known approximately, and useful tabular information is given in this report. From this, the temperature rise of a cable of given diameter suspended on a rack can be determined for a given air velocity by means of a factor which varies with the diameter of the cable and with the velocity of the air. Practical tests were carried out at London, Milan and Buenos Aires. The maximum temperature was observed and is reached when the sky is clear in about half an hour if the cable is exposed to the sun's radiation between 12 noon and 2 p.m. summer time. Under these conditions, cables of about two inches in diameter may show a temperature rise of 17° C. This figure must be deducted from the permissible rise of 50° C. above shade temperature. This materially reduces the permissible current the cable can carry. The results obtained abroad are in good agreement with those obtained in England. In an appendix, the theory of the rise of temperature is given. The agreement of the experimental results with theory is much more satisfactory for the lead-covered cables than for the armoured cables.

An Electric Method for Measuring Young's Modulus. It is well known that a definite relationship exists between the stress and the permeability of iron, steel, nickel and cobalt wires. Joule observed in 1847 that a bar of iron changes its length when magnetised, and forty years later Shelford Bidwell carried out a large number of exact researches in this connexion. He measured the changes of length of wires when placed in a magnetic field both when the wire was loaded and when it was unloaded. Dr. T. F. Wall has developed an interesting electromagnetic method for measuring Young's modulus (*J. Inst. Elec. Eng.*, Dec. 1934; see also NATURE, **132**, 351; 1933 and **133**, 418; 1934). It is based on the fact that, with magnetisable materials, the magnetic permeability changes with strain. When a rod of iron, steel, nickel or certain alloys is placed axially in a solenoid excited by direct current, and the rod is caused to vibrate longitudinally with its natural frequency, the changes of mechanical stress will produce corresponding changes of the magnetic flux in the rod. Hence an electromotive force of the same frequency will be induced in a search coil which embraces the magnetised part of the rod. The frequency of this E.M.F. is measured by means of oscillograms, and from the density of the metal and this frequency the value of Young's modulus can easily be calculated. For the time wave a standard tuning fork was used having a frequency of 500, the vibrations being maintained electrically. The results obtained by experiments on iron rods, mild and hard drawn steel wires and nickel rods are given. They show that satisfactory results are easily obtained.

A Cosmic Ray Meter. A detailed description has been published of a precision recording cosmic ray meter which has been designed by Profs. A. H. Compton and E. O. Wollan, of the University of Chicago, and R. D. Bennett, of the Massachusetts Institute of Technology, for securing continuous records of the variation of cosmic rays at a number of widely separated stations (*Rev. Sci. Inst.*, Dec. 1934). In order to minimise fluctuations, the ionisation sphere has been made of 19 litres capacity, and is filled with very pure argon at 50 atmospheres pressure. It is protected from local radiations by a 17 cm. layer of uniform lead shot, which reduces their effect to about 0·5 per cent of the usual cosmic ray effect. The ionisation voltage is provided by a 650 volt dry battery, and the ionisation current is nearly compensated by that produced in a small chamber within the larger by the beta-rays from an adjustable surface of metallic uranium. The residue current is indicated by a Lindemann electrometer, the shadow of the needle of which is projected by a compound microscope on a moving strip of bromide paper.

Spectra of Giant and Dwarf Stars in the Red. Some interesting luminosity effects, which will serve as very good criteria for distinguishing giants from dwarfs in stars of spectral type *M*, have been discovered by Dr. Y. Ohman through a study of representative stars in the orange and red regions of their spectra (*Astrophys. J.*, **80**, 171). The instruments used were the 60-in. reflector at Mount Wilson Observatory, with the Cassegrain spectrograph and 18-in. camera, giving a dispersion of about 180 A. per mm. at 7000 A. He found that three bands of CaH at 6389–6382 A., 6921–6903 A., and 7305–7208 A. occur conspicuously in the dwarf spectra, but are weak or absent in the giants. These bands first appear (in the dwarf spectra) at type *Mo* and become stronger in later subdivisions, whereas in the giants they are faint throughout. In addition, the spectra of the dwarfs appear smoother than those of giants, on account of the presence of much stronger TiO bands in the latter. The author also confirms Miss Burwell's results for the calcium lines 6162 A., 6122 A., and 6102 A., all of which are very strong in the dwarfs, but faint or invisible in giants.

Chemical Technology at the Imperial College of Science, London

ON January 16, at the invitation of the governing body and the rector, a distinguished company visited the Department of Chemical Technology of the Imperial College of Science and Technology, the occasion providing an opportunity for observing the progress achieved during the past quinquennium

Under the leadership of Prof W A Bone, the Department, which is exclusively of a postgraduate and research character, has continued its policy of pursuing investigations of a fundamental and pioneering character bearing upon what may be termed 'long distance' problems of industry Such work invariably calls for new experimental methods, and a feature of the various apparatus on view was that much of it has been designed in the Department itself and some is unique

The maintenance costs of the Department's extensive research work are naturally heavy, but the support which has always been forthcoming from outside firms and institutions bears ample testimony to the high regard in which its activities are held The chief extramural contributors towards the researches have been the Royal Society (Messel Fund), the Department of Scientific and Industrial Research, the British Iron and Steel Federation, Imperial Chemical Industries Ltd, the Gas Light and Coke Company, the South Metropolitan Gas Company, Messrs Radiation Ltd, Messrs Ferranti Ltd, Messrs Westinghouse Brake and Saxby Signal Co, and Messrs E G Acheson Ltd Altogether, the cost of the research work now amounts to upwards of £9,500 a year, of which approximately 65 per cent is met by special *ad hoc* extramural subscriptions Since its inauguration in 1912, contributions from outside sources towards the research equipment and work of the Department have amounted to more than £60,000 (capital equipment = £15,000), above five-sixths of which has come through Prof Bone

During the afternoon, Prof Bone gave an account of the work of the Department. In subsequent speeches Prof H E Armstrong and Mr H James Yates, chairman of Radiation Ltd, paid a high tribute to it and stressed its scientific and national importance Although Prof Bone will shortly reach the retiring age of sixty-five, they think it would be calamitous if a stringent application of a rule were allowed to interfere with its continuity or with his continued direction of it

Recent advances in the work of the Department, which is divided into sections devoted to fuel technology (including high-pressure gas reactions), electrochemistry and chemical engineering were demonstrated in the various laboratories, and may be summarised as follows —

FUEL TECHNOLOGY

Chemistry of Coal The cost of this work, directed to problems connected with the natural maturing of coal, has been defrayed mainly by grants from the Fuel Research Board It has resulted in (i) new knowledge bearing upon the origin and development of the main 'coking constituents' of bituminous coals, (ii) the discovery not only of the essential 'benzenoid' structure of the main coal substance but also the development thereof throughout the lignin-peat lignite coal-anthracite series

Mechanism of Gaseous Combustion Several investigations have been continued on (i) the combustion of carbonic oxide, (ii) the combustion of hydrocarbons, (iii) flame spectra, etc New evidence has been forthcoming that carbon monoxide burns in two ways, one involving and the other independent of the intervention of steam, also that the initial oxidation product of a gaseous hydrocarbon is the corresponding alcohol as postulated in the hydroxylation theory

High-Pressure Gas Reactions and Explosions The work upon gaseous explosions with which Drs D M Newitt and D T A Townend have been specially associated has been extended to initial pressures of 1,000 atmospheres, the highest yet attempted Nitrogen activation in explosions of carbon monoxide-air media has been shown to reach a maximum at *c* 350 atmospheres, and nearly 6 per cent of nitric oxide to be recoverable from $2CO + 3O_2 + 2N_2$ explosions at 75 atmospheres

Dr Newitt has also developed a new line of work on the pressure oxidation of typical hydrocarbons with the view of elucidating the mechanism of the process and of obtaining large yields of intermediate products A yield of 50 per cent of methyl alcohol has been obtained from methane and 60 per cent of ethyl alcohol from ethane, while toluene has yielded large amounts of benzyl alcohol and benzaldehyde

The high pressure field has also been extended by Dr Townend to the determination of ignition temperatures of paraffin hydrocarbon, etc — air mixtures, with results of great significance both theoretically and in regard to internal combustion problems. Briefly, it has been discovered that the ignition temperatures are located in two widely separated ranges, one usually above 500° C for low pressures and the other below 350° C for high pressures Transference of an ignition temperature to the lower range occurs abruptly at a definite critical pressure, this pressure corresponds with the incidence of 'knock' in an engine at a definite compression ratio

Another centre of interest was an impressive high-pressure apparatus designed by Dr. Newitt for investigations on liquid organic reactions at pressures of 5,000 atmospheres This work, which has been financed by Imperial Chemical Industries Ltd, and is under the joint supervision of Profs Bone and Thorpe, has met with such success that new installations are now in course of erection for pressures between 10,000 and 20,000 atmospheres

Flame Propagation in Gaseous Explosions. This work has consisted mainly of photographic researches, throughout which Mr R P. Fraser has collaborated with Prof Bone and developed the present Fraser high-speed camera of the rotating mirror type whereby detailed records are obtained, capable of measuring flame movements of frequency down to one-millionth of a second Important new knowledge concerning the influence of compression waves, the phenomena associated with 'spin' in detonation and the influence thereon of magnetic and electric fields has been obtained, with the result that a new conception of detonation has been arrived at and is shortly to be published

Blast Furnace Reactions Begun in 1925, under the auspices of the British Iron and Steel Federation, this investigation has also made notable advances, special apparatus having been devised for determining the relative velocities of 'carbon deposition' and 'ore reduction' reactions at various temperatures and high gas speeds as met with in blast furnace operations During the past few years the work, which is carried out by Dr H L Saunders, has thrown such important new light on blast furnace reactions that recently the Federation decided to finance and develop parallel investigations upon actual blast furnace plant With this end in view, a Committee has been formed, with Prof Bone as chairman, to organise and carry out this programme of work

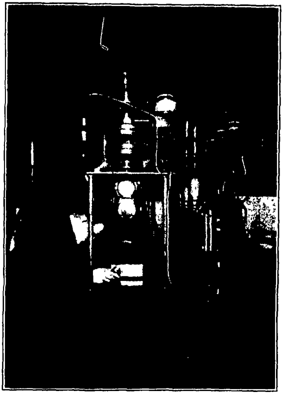

FIG 1 Electron diffraction camera

ELECTROCHEMISTRY

Gaseous Combustion in Electric Discharges and Electrical Ignition Inaugurated in 1925 by Asst Prof G I Finch, these investigations have been continuously prosecuted, and new light thrown on the combustion of hydrogen and carbon monoxide and on the part played by the hydroxyl radical in such circumstances

In addition to having established the excitation view of electrical ignition, a notable improvement in the design of electrical ignition systems for mobile internal combustion engines has been achieved Also as an outcome of work on the analysis of discharge phenomena in ignition, a type of high speed cathode ray oscillograph has been developed which has now been widely adopted in other laboratories

Electron Diffraction and Heterogeneous Catalysis It has been established that electrical condition, catalytic activity and structure of surface catalysts are intimately related Great progress in this field has recently been made possible by the application of the electron diffraction method of structure analysis

A number of precision cameras designed by Prof Finch were on view (Fig 1), other chemical problems being attacked by this new method are (i) corrosion, (ii) electrodeposition, (iii) thermionic and photo-electric emission, (iv) lubrication, (v) properties of colloidal metals, (vi) formation of surface compounds, etc

CHEMICAL ENGINEERING

The chemical engineering section of the Department suffered a severe loss through the death of Prof J W Hinchley in 1931 Since that time, Asst Prof S G M Ure has taken charge of it and is directing work on general problems such as (i) heat transmission, (ii) flow of liquids through granular beds, woven materials, etc, (iii) the distribution of energy in ball mill operations, etc

During the quinquennium, 98 students, 21 of them from overseas, have passed through the Department, of 78 whose locations are known, 63 have passed into industry, 10 into research or business posts and 5 into academic work

Lunar Influence on the East Anglian Herring Fishery

FLUCTUATION in the yield from year to year, from month to month, and even from day to day, is one of the outstanding and disconcerting characteristics of all herring fisheries For thirteen seasons, 1921–1933 inclusive, careful records have been kept of the amount of herrings landed daily at Yarmouth and Lowestoft during the late autumn (October-November) fishery off the East Anglian coast These figures of daily landings have now been submitted to detailed analysis by the scientific staff of the Ministry of Agriculture and Fisheries, Lowestoft, who find that they reveal a definite monthly rhythm in the catches, the maxima coinciding with the period of full moon*

When the moon is at full in the first week of October its effect is but slight, but the landings gradually increase as the season advances, to culminate in a peak during the week of November full moon In these circumstances, it is only the middle and later parts of the season which produce good catches A full moon occurring in the second week of October produces a pronounced peak in the curve of landings, this maximum being followed by one of approximately equal magnitude in the week of November full moon Full moon in the third week of October produces a still more pronounced peak for this period, but the corresponding November full moon is considerably less effective Finally, when the moon is at full during the fourth week of October, it produces the largest peak of all, but the late November moon is accompanied by a rise so slight as to be of little benefit to the fishery.

From these observations it follows that the best prospects for a successful fishery—at any rate from the point of view of production—are found when the October full moon occurs in the second week of the month. When this happens, the combined effects of the October and November moons are greatest, and a period of about five weeks good fishing may be expected. A very late October full moon is the least promising of all, for then only one prominent peak occurs in the fishery. The period of good fishing is therefore very short, and if it should happen that the activities of the fishing fleet be restricted by adverse weather conditions at this time, the chances of a successful fishery in that season are extremely slight.

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* *Lunar Influence on the East Anglian Herring Fishery* By R E Savage and W C Hodgson *Journal du Conseil*, 9, No 2, 1934, pp 223–239

The occurrence of these peaks in the curves of landings during the weeks of full moon is held to be more than coincidence, and the data certainly appear adequately to support this view. The authors are at a loss, however, to suggest an explanation for this correlation between the yield of the East Anglian herring fishery and a phase of the moon. This task is made all the more difficult by the fact that the same correlation is not exhibited by the herring fisheries in other localities. Either there is no obvious correlation at all between the landings and the moon's phase—as in the Scottish fisheries—or the peaks occur during a different phase of the moon—as at North Shields, where the maxima occur during the 'first quarter'.

It should be emphasised, however, that failure to find an explanation of the influence exerted by the moon on the great East Anglian fishery in no way detracts from the value of the observations which have demonstrated its existence. The authors are therefore to be congratulated upon having fully achieved the two-fold object of their investigations. In a notable advance towards the making of more accurate forecasts of fluctuations in the yield of an important fishery, they have succeeded also in adding materially to the sum of our knowledge concerning lunar periodicity in the behaviour of animals.

G. A. S.

University and Educational Intelligence

CAMBRIDGE.—The Vice-Chancellor announces a further gift from Dr. G. P. Bidder, of Trinity College, for the benefit of occupants of the Cambridge table at the Zoological Station in Naples. For three years Dr. Bidder has made annual payments of 5,000 lire into a Naples bank for the maintenance of occupants of the table during their sojourn in Naples. He now offers to deposit in that bank securities which, by the use of principal and interest, will provide 5,000 lire annually for the same purpose, for a further period of ten years. The professor of zoology will have discretionary powers over the fund.

The Goldsmiths' Company has made a grant of £5,500 for defraying the expenses of an investigation of the alloys of silver, to be carried out in the Metallurgy Laboratory under the guidance of Prof. R. S. Hutton, professor of metallurgy at Cambridge. The grant is to be spread over three years.

AN American "Educational Review" published as a supplement to *School and Society* of December 1 conveys the impression that school teachers in the United States are to-day very much on the defensive. Awakening from a dream of heaven-ordained security, they recognise that they have lost much of the unquestioning popular reverence they and their predecessors enjoyed for generations, and are no longer taken seriously as oracles of civic wisdom. If the President's 'new deal' is to provide old-age pensions and unemployment insurance, there will, it is felt, be a danger of these social services being financed in part by encroaching on school budgets. The same review comments on the progress of adult education with special reference to an 'alumni education' movement which is peculiar to America. Among its manifestations are mentioned a three-day conference at Seattle on present day economic and political problems, in which a thousand alumni of the University of Washington participated, similar conferences of alumni of other universities and an annual two-week Institute of Public Affairs organised by the University of Virginia.

Science News a Century Ago

The Entomological Society

The anniversary meeting of the Entomological Society was held on January 26, 1835, J. G. Children, Sec. R.S., the president, being in the chair. After the passing of the minutes and accounts, the president delivered an address in the course of which he congratulated the Society on the progress of entomology and the favourable report which had just been read, while the secretary followed with a sketch of the progress of the science at home and abroad. The officers elected for 1835 were: *President*, Rev. F. W. Hope; *Treasurer*, Mr. Yarrell; *Curator*, Mr. Pickering; and *Secretary*, Mr. Westwood.

Royal College of Physicians

The president of the Royal College of Physicians from 1820 until 1844 was Sir Henry Halford (1766–1844), who was physician in turn to George IV, William IV and Queen Victoria. On January 26, 1835, according to *The Times*, the evening meetings of the Society were commenced at the College in Pall Mall. Sir Henry Halford was in the chair and the meeting was attended by about seven hundred persons including many distinguished statesmen, lawyers and others. The meeting began at 9 o'clock and the company dispersed at 11 o'clock. The president, said *The Times*, read a very interesting paper containing some observations on the treatment adopted by medical men from a very early period, in the care of various complaints, and related many amusing anecdotes of the remedies they applied. He described the different complaints which terminated the lives of the monarchs who governed Great Britain, and also explained the circumstances attending the deaths of Addison, Dryden, Dean Swift and other distinguished characters.

Steam Navigation upon the Danube

Under the above heading, the *Athenaeum* on January 31, 1835, said: "Very gratifying accounts have recently been received of the progress of steam navigation upon this noble river. Under the auspices of the Austrian government, the whole region from Presburg to the Black Sea, and even to Constantinople, a distance of fifteen hundred miles, has lately been opened to the influence of steam. This project was first undertaken by Count Czechengi, a Hungarian nobleman of great fortune and very enlightened mind, who in quest of mechanical information, has made several journies to this country. Unlike the majority of the Hungarian nobles the Count has exhibited the most enthusiastic devotion to the improvement of his country, by the introduction of the useful arts, and his operations for improving the navigation of the Danube have been upon a scale so vast, as to entitle him to the appellation of the Bridgewater of the German States. . . ."

Societies and Academies

CRACOW

Polish Academy of Sciences and Letters, December 10 W PIECHULEK and J SUSZKO New stereochemical studies Optical isomerism of the α phenylsulphinyl phenylacetic acids The results are in agreement with the hypothesis of two centres of asymmetry, one round the carbon and the other round the sulphur atom K DZIEWONSKI and MLLE J SCHOEN The reactions of diphenylthiourea with the hydro aromatic ketones WL SZAFER The rose genus (*Rosa*), "Polish Flora" (vol 5) ANDRÉ SRODON Researches on the diluvial vestiges of plants belonging to the family Nymphaeaceæ MLLE M GAWLOWSKA The Naïades in the Polish diluvium Z GRODZINSKI Researches on the development of the vascular area in the chicken MLLE S BOJARCZYK The form of the cells of the cerebral cortex in domestic and in wild animals Gurewicz and Szatszaturjan have described pyramidal cells in the cortex of animals in the wild state, while in domestic animals round cells have been observed The author shows that the form of the cell depends on the mode of fixing and time elapsing after removal from the skull MAX ROSE (1) The hypothalamus of the rabbit (2) The parts of the thalamus in relation with the cortex in the rabbit (3) The metathalamus and the epithalamus of the rabbit J STACH The genus *Odontella* and its species

GENEVA

Society of Physics and Natural History, November 15 KURT MEYER · Contribution to the theory of narcosis The author by his experiments gives support to the lipoid theory of narcosis. E BRINER, E ROKAKIS and B SUSZ Researches on the oxidation of the nitrogen oxides in the presence of ozone. M GYSIN . The basic igneous rocks of the Haute Lufira (Belgian Congo) In the Haute Lufira basin (Katanga) numerous outcrops of uralitised diabases have been observed, containing a blue soda amphibole and a little dipyre The blue amphibole forms borders round the uralite regions , the dipyre occurs as small grains mixed with the products of the saussuritisation of the plagioclases The uralitisation, the formation of blue amphibole and the scapolitisation can be attributed to the action of perimagmatic or apo magmatic mineralised solutions on the diabases D ZIMMET A practical sphygmograph for man and animals

MELBOURNE

Royal Society of Victoria, November 8 KATHLEEN M CROOKS : (1) The cultural and cytological characteristics of a new species of *Mycogala*. While isolating several fungi from Jarrah (*Eucalyptus marginata*) timber a new species of *Mycogala*, *M marginata*, was obtained There are two types of asexual spores · (*a*) chlamydospores, spherical in shape and dark brown in colour with a thick wall when mature, and ranging from 6 to 18 μ in diameter , (*b*) oidea, formed by the transformation of aerial branches into cylindrical, hyaline elements which again break up into smaller segments one or more septate Perithecia are abundantly developed The perithecium initial is a coiled septate hypha—the ascogonium composed of segments at first multinucleate, but later becoming uni-nucleate An antheridium is not developed From the ascogonial coil ascogenous hyphæ arise These branches are rather irregular and recurved at the tip The ripe asci contain eight spherical hyaline ascospores, 2–4 5 μ in diameter (2) A powdery mildew of *Boronia megastigma* —In September and October 1933, *Boronia* growing at Healesville was found to be diseased The disease was a powdery mildew' caused by a species of *Oidium* The fungus attacked the petals while the stem and leaves appeared quite healthy From the vegetative mycelium, aerial branches arose and at the apices of these hyphæ, oidia were contracted The oidia were ovoid in shape and had an average size of 28 μ × 13 μ and a range of 19–38 μ × 11 18 μ In the family Rutaceae to which *Boronia* belongs, there are few members which have been attacked by *Oidium* species, but the characteristics of the form on *Boronia* do not agree with any of those previously described Hence it is proposed to give the fungus in question the specific name *Oidium boroniae* ILMA G BALFE Sclerote-forming fungi causing disease in *Matthiola*, *Primula* and *Delphinium* in Victoria *Rhizoctonia solani*, Kuhn, is recorded as causing 'damping off' of *Matthiola incana* seedlings in Victoria *Sclerotinia minor*, Jagg , is recorded as causing a collar rot of *Primula malacoides* in Victoria *Corticium centrifugum* is recorded as causing a collar rot of delphiniums in Victoria A description of the pathogen in culture is given, and comparisons are made between the strain isolated from *Delphinium*, Wolf's strain of *Corticium centrifugum* and Whetzel's strain of *Sclerotium Delphinii*, Welch EILEEN E FISHER 'Sooty mould' of the tree fern, *Dicksonia* A dense black film on the fronds of a *Dicksonia* plant growing in a fernery at Doncaster, 11 miles east-north east of Melbourne, is due entirely to the fungus *Teichospora salicina* (Mont), Gau

ROME

Royal National Academy of the Lincei Communications received during the vacation of 1934 G SCORZA The structure of pseudo null algebras G A CROCCO Static and kinetic stability of aeroplanes G ROVERETO Post Pliocene epiro genesis of the maritime Alps and of the Ligurian Riviera S RIOS The ultra-convergence of Dirichlet's series GH TH GHEORGHIU A special case of metaspherical functions S FINIKOFF Couples of surfaces whose asymptotics correspond and whose homologous asymptotic tangents intersect A MASOTTI · The discontinuous plane motion induced in an indefinite rectilinear lamina G GARCIA Einsteinian correction of the time in planetary movement (2) N MOISSEIEV Curves defined by a system of differential equations of the second order (1) A method of qualitative analysis applied to dynamic problems with two degrees of freedom G B RIZZO . The influence of the terrestrial atmosphere on the effect of latitude in the intensity of cosmic radiation The view is expressed that the influence of the bulging of the atmosphere in equatorial regions should be taken into account in considering the diminution observed in cosmic radiation at the equator S FRANCHETTI : Interatomic forces and oscillation frequencies of the atoms in lattices. SILVIA RESTAINO · *Double sulphates of the rare-earth and alkali metals* Investigation of the system $Pr_2(SO_4)_3 - K_2SO_4 - H_2O$ reveals the existence of six double sulphates The following compounds are also formed : $Pr_2(SO_4)_3$, Rb_2SO_4, $8H_2O$; $Pr_2(SO_4)_3$, Cs_2SO_4, $8H_2O$, $Sm_2(SO_4)_3$, Na_2SO_4, $2H_2O$ and

$4Sm_2(SO_4)_3, 5Na_2SO_4, 8H_2O$ P Principi Observations on the analogies existing between the tertiary deposits of Albania and those of central Italy A Cavinato · Contribution to the knowledge of the petrography of Sardinia A characteristic Kersantitic vein with prasinitic facies in Sarrabus A Mirri Diagnosis of *Brucella* in animals *Brucellina Mirri* A method is given for obtaining a brucelline preparation which serves as a sensitive means of diagnosing *Brucella* in animals, and has advantages over the agglutination test for this purpose R Savelli Observations on some elaborates of the cells of the chlorenchyme G Amantea The effects of slow and repeated asphyxia in an enclosed space D Gigante Observations on the course of the reconstructive processes in the pigeon

Vienna

Academy of Sciences, November 8 Rudolf Kanitscheider Mechanics of the Fohn (south wind) K W F Kohlrausch and F Koppl The Raman effect (38) The Raman spectrum of organic substances (isomeric paraffin derivatives) Repetition of previous measurements and examination of a number of new compounds give results which are considered in relation to free rotatability These results, and also the intensity differences in the spectra of paraffins containing chlorine, bromine or iodine as substituents, are in agreement with the view that the rotation leads to two different, stable space-forms The spectral transition, $CCl_4 \rightarrow CH_3\,CCl_3 \rightarrow (CH_3)_2\,CCl_2 \rightarrow (CH_3)_3\,CCl \rightarrow (CH_3)_4\,C$ is also discussed K W F Kohlrausch and A Pongratz The Raman spectrum of polysubstituted benzenes The vibration spectra of the nucleus substituted benzenes, $Cl\,C_6H_4X$, where $X = NH_2$, OH, F, CN, Br, or I in the ortho , meta , or para position, are described

November 14 Ernst Beutel and Artur Kutzelnigg . The action of liquid bromine on cellulose Contrary to previous statements, bromine is able, under suitable conditions, to dissolve cellulose fibres completely, the time required varying from several weeks at the ordinary temperature to a few minutes at 100° C Jovan Jurišić The identity of *Bryophyllum cochleatum*, Lemaire, with *Bryophyllum proliferum*, Bowie, with biological remarks

November 22 Leopold Portheim, H Steidl and F Kock . Orienting investigations on the influence of ultra short waves on blossoms Leopold Portheim and O Ried Influence of ultra short waves on salt solutions previously irradiated with ultra-violet light. B Nussbaum and Th Senekovic Callus formation in herbaceous plants Ernst Chwalla and Johannes Jaumann The magneto-elastic method for the direct measurement of forces in the iron in ferro-concrete structures Elise Hofmann, Wilhelm Kühnelt and Julius Pia Evergreen oaks in the alluvium of Lower Austria Eugen Guth The mutual action between rapid electrons and atomic nuclei Erich Hajek Potentiometric examination of hydroxide precipitation Anton Skrabal and Hellmut Schreiner Velocity of reduction of chloric and bromic acids The velocity with which chlorates and bromates are reduced by chlorides, bromides and iodides in acid solution is proportional to the concentrations of the oxy-salt and halides and to the square of the acidity With the bromate-bromide reaction, the velocity is proportional to the square of the concentration of the bromide, if this is high

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, January 27

British Museum (Natural History), at 3 and 4 30 — M A Phillips "Gem Stones" *

Monday, January 28

British Museum (Natural History), at 11 30 —F C Fraser "Stranded Whales on the British Coast" *

Victoria Institute, at 4 30 Dr K B Aikman "Race Mixture with some Reference to Bible History"

University of Leeds, at 5 15 —Prof W J Tulloch "The Virus Agents considered as a Problem of General Biology" *

Royal Geographical Society, at 5 30 —Miss E J Lindgren "Winter and Summer Travel in the North Manchurian Woods" (Film)

Royal Society of Arts, at 8 Dr Harriette Chick "Diet and Climate" (Cantor Lectures Succeeding lecture on February 4)

University of Glasgow, at 8 30 -Sir Robert Greig "National Progress in Agriculture" *

Tuesday, January 29

Royal Society of Arts, at 4 30 - H. C Sampson "The Royal Botanic Gardens, Kew, and Empire Agriculture"

Thursday, January 31

Bedford College for Women, at 5 15 —Dr J K Fotheringham "Ways of Measuring Time—Ancient Clocks" *

Friday, February 1

Westfield College, London at 5 15 —Sir Arthur Eddington "Cosmic Clouds and Nebulæ" *

Royal Institution, at 9 --Prof F Simon "The Approach to the Absolute Zero of Temperature".

Official Publications Received

Great Britain and Ireland

County Borough of Southport Meteorological Department The Fernley Observatory Southport Report and Results of Observations for the Year 1933 , with an Appendix By Joseph Baxendell Pp 31 (Southport)

Ministry of Agriculture and Fisheries Collected Leaflets, No 3 Diseases of Potatoes Pp iv + 74 + 9 plates (London H M Stationery Office) 1s 6d net

Board of Education Science Museum Rubber Exhibition (November 1934–April 1935) A Brief Account of the History of Rubber from its Source to the Finished Product and a Descriptive Catalogue of the Exhibits Compiled by the Rubber Growers' Association Pp 44 + 4 plates (London H M Stationery Office) 6d net

Other Countries

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 83 Natural Pastures , their Response to Superphosphate By Dr J Griffiths Davies, A E Scott and K M Fraser Pp 76 Pamphlet No 49 Some Important Poison Plants of North Australia Compiled by the Poison Plants Committee Pp 44 (Melbourne Government Printer)

Smithsonian Institution Freer Gallery of Art Oriental Studies, No 2 A Descriptive and Illustrated Catalogue of Miniature Paintings of the Jaina Kalpasūtra, as executed in the Early Western Indian Style By Prof W Norman Brown (Publication 3252) Pp v + 66 + 45 plates (Washington, D C Smithsonian Institution)

Contributions from the Physical Laboratories of Harvard University for the Years 1932 and 1933 Vol 22 Pp iv + 506 (Cambridge, Mass Harvard University)

Department of Agriculture, Trinidad and Tobago Vol 1, Part 6 Flora of Trinidad and Tobago—Myrtales (Pars) By R O Williams, Pp 333–410 (Trinidad Government Printer) 3s

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Scientific Aspects of Housing Problems

THE fundamental scientific problems of the building industry which underlie the housing question were touched upon by Dr Stradling in a lecture on "Physics in the Building Industry" at the end of 1933, and again by Sir Harry McGowan in the Messel Memorial Lecture to the Society of Chemical Industry at Cardiff They have also been indicated by Prof Julian Huxley in his "Scientific Research and Social Problems" and in much greater detail, so far as the United States of America are concerned, by Mr A F Bemis in "The Economics of Shelter", the second of three volumes in a series "The Evolving House"

Nothing corresponding with the latter study has hitherto appeared in Great Britain, but a report entitled "Housing England", which has now been produced by the Industries Group of Political and Economic Planning (PEP), 16 Queen Anne's Gate, S W 1, ably fills this gap and is an important contribution to the discussion of the housing question which deserves close consideration by the scientific worker If studied in conjunction with the housing statistics of the Census of 1931 just available, it will help to create a more scientific, more critical and more constructive attitude towards the problems of housing and of the building industry

Although a comparatively small section of the report is devoted to actual research problems, this attitude supplies its outstanding characteristic It recognises from the start that any sound solution of the housing problem must provide for reconstruction of the building and building materials industry, overhaul of building regulations and the setting up of national standards The discussion accordingly ranges over wide fields of industrial and technical as well as of economic and social questions

The core of the present housing problem in Great Britain is that of supplying suitable accommodation at rents within the means of the lower-paid workers of the community The final report of the National Housing Committee stated that this represented the provision during the next ten years of at least a further million houses to let at rents of not more than 10*s* per week The present report reaches essentially the same conclusion, estimating that a minimum of 200,000 new houses a year is required for the next seven years, of which half must be available at rents averaging 10*s*. per week

Leaving on one side the discussion of the political and financial aspects of this question, which the report suggests might be dealt with by means of a national housing company and a national building company, attention is directed to the unjustifiable variations in building costs throughout the country of the more or less standard three-bedroom non-parlour house Technical and economic research on a comprehensive scale is essential for the attack on building costs While such a research programme is properly the function of the building industry as a whole, the industry has not yet developed a collective organisation capable of undertaking the work Accordingly the report regards it as essential that the Government should initiate a centralised housing research organisation to co-ordinate existing efforts so far as possible through existing organisations

This is one of the most important recommendations of the report, and the section entitled "Research and Statistics" on which it is based, will be read with close interest by all scientific workers. At present even market research in the building industry is remarkably casual and incomplete, and largely in the hands of advertising agents Vital information on proprietary and non-proprietary materials is unobtainable or obtained with difficulty owing to the law of libel Lack of knowledge about building regulations, which vary from district to district, hampers the operations of building concerns outside their own immediate area The possibilities of economics dependent upon improved management technique, such as the Taylor or the Bedaux systems, and the whole field of industrial psychology, have scarcely been considered or explored by the building industry. Much of the existing scientific work is not applied so quickly as it should be because its results either do not receive adequate publicity or are published in unsuitable form

At the present time, there appears to be almost unlimited scope for the improvement of the facilities for the exchange and co-ordination of information on building progress, building technique, trade names and catalogues, co-operation between libraries and the like Such work inevitably tends, moreover, to overcome one of the difficulties in the way of introducing new methods and the obstacles which the lack of scientific personnel presents to the practical application of research One of the functions of such a central authority might well be the co-ordination of information on training facilities, the type of instruction required, openings, etc

This economic and statistical research is intimately related with the technical research work discussed in the same section of the report The scarcity of men with a scientific training on the contracting side of the industry is in extraordinary contrast with the executive branches of engineering or even cotton, and presents a very serious obstacle to progress The expenditure on research by the industry itself is noticeably smaller in proportion to Government expenditure than in other trades, but the wide scope of the industry is one of the reasons why scientific research has made so little headway In addition, research of fundamental importance to the industry is being carried out by other industries, though rather from the point of view of the manufacturer than from that of the consumer Special stress is laid upon the necessity for adequate research from the latter point of view, on the need for full-scale experiments and on the importance of adequate financial support for the Building Research Station

The most important criticisms advanced of existing research organisations are the lack of direct co-operation in direction, and their inability in a non-scientifically minded industry to get the results of their work accepted by the industry The danger of research financed by or carried out mainly for proprietary material interests is also stressed, as is the need for an authority which would facilitate experiment with new systems of construction

One of the chief obstacles to such experiment lies in the chaotic legislative position affecting building and the building industry, particularly the restrictive and antiquated regulations which, in effect, limit the rate of introduction of new materials and new methods Despite the attention directed to this important factor by the first report of the Council for Research on Housing Construction ("Slum Clearance and Rehousing", P. S King and Son, Ltd., Great Smith Street, S W 1; 1934), which asserted that the diversity and obsolescence of building regulations is a principal obstacle to progress and recommended the amendment and more enlightened administration of the system, as well as a more flexible system of by-laws, insufficient attention has yet been given to this factor

Examples quoted in the report of obstacles to the introduction of improved lead piping, fire-proofing practice and the like indicate the absurdity of the present position Here, as elsewhere, there is to be found a plethora of evidence that the statement quoted by Mr Bemis from a leading American engineering publication is equally valid in Great Britain "The average house to-day is a shoddy affair, of high first cost, and soon reduced to a condition requiring constant maintenance, it is built as it was a great many years ago, by hand methods, with every piece cut in the field by men whose horizon is limited to the locality in which they live, whose training makes them impervious to the adaptation of new methods, whose financial capacity does not permit of modern research or study and who themselves are the victims of profiteering material dealers "

If the report produced by Political and Economic Planning reveals very clearly the immense difficulties in the way of a really scientific housing policy, and in placing building and the building industry on a satisfactory scientific basis, it is far from being a depressing document Its lucid and constructive criticism and pertinent recommendations do not merely point the way forward and assist in the clarification of public opinion on this important matter They also reveal the wide field which here confronts the scientific worker, both as such and as a citizen, to secure that public policy and action are determined by definitely ascertained facts and not by archaic tradition or prejudice

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Reviews

Early East Africans

The Stone Age Races of Kenya By Dr L S B. Leakey With Appendices by T W. P Lawrence, Sir Grafton Elliot-Smith, Sir F Colyer, L S B Leakey Pp xii+150+82 plates (London. Oxford University Press, 1935) 38*s* net

DR LEAKEY led his first archæological expedition to East Africa in 1926, his second in 1928, and his third in 1931 In this imposing memoir, he gives an account of the human remains found on all three expeditions Rich as were the discoveries made in the first and second expeditions, they were thrown completely in the shade by the outstanding importance of those made during the third expedition.

Dr Leakey's third expedition began by a visit to the site of the discovery of Oldoway man in Tanganyika Territory In the Oldoway district the examination of the grave site was a minor matter, for it was in this area that Dr. Leakey discovered a sequence of deposits bearing evidence of the presence of man in East Africa from the earliest Pleistocene times onwards, and by early Pleistocene Dr. Leakey means what most geologists call late Pliocene He speaks of the 'culture' represented by the implements in the oldest deposit as Oldowan—a crude and very early form of hand-axe. Overlying deposits reveal this early type of stone axe in the process of being transformed into the true Chellean and later into the Acheulean form of *coup-de-poing*

In Tanganyika, Dr. Leakey found nothing of the men responsible for the early hand-axe industry, but early in 1932 he moved his expedition to that part of Kenya Colony which extends to Kavirondo Bay, on the eastern shore of Lake Victoria, and had his search crowned with success almost immediately The land into which he came was made up, just as at Oldoway, of deposits laid down in the Early and Middle Pleistocene periods; only the fauna at Kanam—the site of the most important discovery—was rather of an earlier date than the oldest at Oldoway There were the same crude stone implements in the basal deposits at Kanam as at Oldoway

Very soon after its arrival on the eastern shore of Lake Victoria, the expedition had the fortune to find at Kanam a fossil fragment near the base of the Pleistocene deposits This fragment represents the front part of the lower jaw of one of the earliest human beings known to us Never, perhaps, was a more puzzling piece placed in the hands of a student of fossil man. That it is human and that it is very ancient there can be no doubt But by a very strange coincidence, the chin of this representative of early humanity was the seat of a bony tumour of an exceedingly rare kind. The tumour, which grew from the deep aspect of the lower jaw, just behind the chin, has spread over and obscured the normal features of this region Enough remains, however, to make quite certain that in dimensions and in its features, the chin region of this early being was shaped as in primitive types of living humanity—such as the aborigines of Australia Dr Leakey describes the Kanam man as having "a very pronounced mental prominence". Far from being "very pronounced" the Kanam "mental prominence" or chin represents a low or early stage of chin development.

Dr Leakey does not hesitate to infer that the rest of the Kanam man will prove to be in keeping with the fragment of his jaw, and regards him as the ancestor of modern races of mankind—*Homo* *sapiens* This may prove to be the case, but it may not The fragment of lower jaw, which is of the same age as *Pithecanthropus*, and which Dr. Dubois attributes to *Pithecanthropus*, has a human chin region , if Dr Dubois had merely found this fragment, he would have presumed that *Pithecanthropus* was an early representative of *Homo sapiens*, as indeed it may prove to be The lower jaw of some of the Peking fossil men (*Sinanthropus*) show an incipient development of the human chin If Sir Arthur Smith Woodward had been given only the chin region of Piltdown man, he would certainly have inferred that a Pleistocene anthropoid ape had been discovered in England Kanam man, when Dr Leakey discovers him, may be quite unlike his anticipation, for we can place no great reliance on the chin as a clue to the structure of the rest of the body

Dr Leakey does not consider the Kanam fragment in connexion with the most important of all fossil Africans known to us, namely, Rhodesian man The size and shape of the Kanam premolar teeth, the flatness of their worn surface and the massiveness of the chin region (Dr Leakey estimates that the height of the symphyseal region was 42 mm) indicate just such a lower jaw as might be postulated for Rhodesian man

It is said that Dr Dubois went to Java in 1888 to find the 'missing link', he found *Pithecanthropus* Dr. Leakey, in March 1932, went to the Kavironda country to find the fossil ancestor of modern man He not only discovered the fossil fragment of Kanam man but also at a neighbouring site—Kanjera—found fossil fragments of four other skulls The Kanjera people, however, are later than the Kanam man They fall at that phase of the Mid-Pleistocene when hand-axes had reached their full Chellean development Two of the Kanjera skulls have been reconstructed by Dr Leakey They represent big-headed and big-brained people Their heads were long and narrow Dr Leakey claims that the Kanjera people are by far the earliest representative of true modern man that has been discovered so far That is so, but there are certain very important characters of these fossil skulls which Dr Leakey passes over without mention and yet which, in the opinion of the reviewer, are of the utmost importance for racial recognition These points are the flatness of the glabellar and interorbital regions at the root of the nose, and the form of the external angular processes of the forehead These are features of the Kanjera skulls and are characters of the Negro race So, too, are their 'infantile' traits, on which Dr Leakey rightly lays emphasis. More than in any race, the Negro tends to retain fœtal and infantile stages in development and growth, as we see in the tendency of this race to throw dwarf forms—such as the Bushman and Congo pygmies. Far from being marked by "generalised characters" as Dr Leakey assumes, the Kanjera people are already endowed with features which definitely assign them to the African or Negro stock Indeed, Dr Leakey's discovery is one of the utmost importance to anthropologists, for it reveals for the first time the differentiation of a modern race of humanity in Mid-Pleistocene times The great enigma, the origin of the modern races of mankind, is brought a big step towards solution We are to find that "parallel or independent evolution" is to play a large part in the differentiation of the modern races of mankind

The other races discovered by Dr Leakey, representing the inhabitants of East Africa in Late Pleistocene and in the Early Post-Pleistocene times, need not detain us long A large part of the present work is devoted to them One is impressed by the prevalence in all these periods by a tall, long-headed, big-brained, heavy-faced type of man It is a type which can still be recognised amongst the native peoples of East Africa and in the upper watershed of the Nile It is a Hamitic or Negroid type, certainly not a pure Negro form Measurements of their bones and drawings of their skulls are given to an extent which will satisfy the most exacting of readers.

Beyond a doubt the discoveries which Dr Leakey has made, and to which the book under review is devoted, take a place among the major events in the calendar of all anthropologists No one can now discuss the rise of humanity and the evolution of early 'cultures' without taking Dr Leakey's discoveries in East Africa into consideration Nor has the work of anyone been given a finer setting than the Oxford University Press has given to "The Stone Age Races of Kenya" That makes it all the more regrettable that many of the plates show crude draughtsmanship and much of the text evidence of hurried composition.

ARTHUR KEITH

The R.S.P.C.A.

A Century of Work for Animals the History of the R S P C A , 1824–1934 By Edward G. Fairholme and Wellesley Pain. Second edition Pp xx+308+8 plates (London · John Murray, 1934.) 2*s*. 6*d*

THE century's work of the Royal Society for the Prevention of Cruelty to Animals was published in 1924, and now a second edition carries that history on through the succeeding decade. Both this and the analogous Society in respect to children have done notable work in directing the attention of the public to cruelty in whatever form they found it. They have used the law courts, the decisions of which attract the public and are educative in themselves The times too have been favourable, for education became compulsory in the latter half of last century and has been increasingly conducted by men of broad outlook and knowledge With the spread of scientific knowledge, it is difficult to conceive of avoidable cruelty now being countenanced by educated men, since all such would naturally be imbued with the ideas of evolution and with the close relationship, even ancestral, that this implies between man and beast

The successive 'ages' of amphibians, reptiles and mammals were established, with the implied replacement of older forms by descendants better adapted to cope with the difficulties of life Often the establishment of a new age was a cruel process, for Nature's unalterable laws are often cruel This, however, is no longer the age of mammals but the age of man, and this age has not been established without cruelty not only to mammals but also to less intelligent races of man Now man is becoming highly mechanised With civilisation his whole life is artificial However, with this there would seem to be a development of a humane instinct for Nature, seen practically in the growth of Nature reserves and national parks Unfortunately, scarcely one of these can be left to itself, since a few animals and plants in each soon dominate to the exclusion of weaker types Man has to rule, but fortunately the instincts for civilisation and kindness seem firmly coupled

From the history before us we gain the impression that the Society's activity has been largely directed to securing penalties for inhumanity and inventing more humane methods of necessary slaughter, together with such propaganda as was desirable to secure these and to make detestable the needless destruction of wild creatures To-day, any case of inhumanity excites detestation, and such cases can be increasingly left to the community In the present story no chapter deals with future work, yet the Society must be aware that it cannot rest on its laurels and still flourish Is not there a wide field before it in encouraging the study both of the feeding and of the diseases of domestic animals, thereby ultimately alleviating their lives ? Is not the development of veterinary science to a position akin to that of medicine increasingly to be desired ? How far can Government-managed laboratories be expected to concentrate on our pets ? Assuredly the funds would be forthcoming if the Society would establish its own research institute in the interests of such 'low priced' beasts.

Furthermore, while for forty years we have ceased to mutilate our dogs for the show bench, are any of our methods for the minor beasts causing them pain ? What are our aims when we breed these in captivity ? Are we breeding for stamina and health and intelligence, three factors which apparently mean happiness to their possessors ? Or is our aim merely to secure the money of lovers of the bizarre, forgetting that monstrous developments in any form are frequently accompanied by loss of stamina and brain ? Not to consider the nature of any pet is cruel and inhumane, and surely a pet must not be regarded as the inane doll of its owner.

The Society's position as to vivisection is that it "deprecates all experiments on animals which cause pain" This is exactly the position of scientific men of all shades of thought, but they recognise that their first duty is to alleviate the sufferings of their children, even if they require very occasionally to learn how to do so at the expense of animals In other words, they follow the law of Nature which to-day has assigned pride of place to man To judge by its précis of evidence before the Royal Commission of 1907, the Society was scarcely fair It did not distinguish between painless inoculations and experimental operations, or between those of Governmental and private, usually university or hospital, laboratories Without any new Act of Parliament, so far as we can judge, every change asked for by the Society or the Commission has been effected administratively. There is an unbribable inspectorate of the highest class, the most rigid control and a universal employment of anæsthetics No operations are possible except for definite and approved ends ; and to crown all, there is the universal opinion of the scientific world deprecating cruelty and any attempt to evade the Act Indeed, the British faculty for compromise would appear to have reconciled desirable sentiment with practical necessities, and the Society would do well to recognise this

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Bessel Functions for Engineers

Bessel Functions for Engineers By Dr N. W McLachlan (Oxford Engineering Science Series) Pp xii+192 (Oxford Clarendon Press ; London Oxford University Press, 1934) 15*s* net

THE value of Dr McLachlan's book to engineer users of Bessel functions will depend on the kind of engineer who refers to it. Probably the electrical or acoustical engineer will be well pleased and all other kinds relatively disappointed The preface makes the contents quite clear, but had the book been called "Bessel Functions for Wireless Engineers" a more correct impression of its contents would have been given.

A general indication of the problems selected for consideration by the author will show the scope of the book; he deals with loud-speaker horns, electrical transmission lines, alternating current density and skin effect in wires, electric furnaces of eddy current type, etc. Another group of subjects covers the vibration of stretched membranes, the lateral vibrations of a conical bar and the 'virtual mass' added to a body when accelerating through a fluid. On these subjects the book is adequately self-contained.

The general pattern of the chapters is a beginning of theory and an ending of examples. The latter are very numerous—some six hundred in all. The author's statement that the book has been used with success for a course of lectures to practising engineers can readily be accepted as true, but the question still remains as to what the author meant by the expression "for engineers". Probably Dr. McLachlan had in mind the textbook by G. N. Watson as one suitable for mathematicians rather than engineers since a considerable analytical skill is required to extract working formulæ from that treatise. On the other hand, there is the book by Gray, Mathews and MacRobert, and we should hesitate to describe that as unsuitable for engineers; in fact, almost the whole of the theoretical part of Dr. McLachlan's book is to be found in the same form in MacRobert's, but in the latter there is additional matter with engineering applications. Such extra matter covers the addition theorems and the contour integrals which Dr. McLachlan deliberately leaves out. Such integrals are not obtrusive in MacRobert's work and the general arrangement of the theoretical part in that work may be preferred to that of the new volume. It may be that familiarity with the older work has produced a bias in its favour.

It is pleasing to find the author stressing his belief that "it is rather hazardous to solve practical problems with a book in one hand and a pen in the other without a proper knowledge of the processes involved", and within its admitted limitations the whole book satisfies the criterion laid down by giving adequate discussion of the theory behind the applications.

The book ends with certain tables of Bessel functions comparable in value to the tables in Jahnke and Emde and much less accurate than those of Watson and MacRobert. Perhaps a textbook on Bessel functions is no longer a suitable place for it, but a comprehensive collection—not limited to four significant figures—would be welcomed by some engineers. Lack of even a moderately complete set of tables seems to detract appreciably from the practical value of Dr. McLachlan's book.

L. B.

Short Notices

Neuroanatomy: a Guide for the Study of the Form and Internal Structure of the Brain and Spinal Cord. By Prof. J. H. Globus. Sixth edition, revised and enlarged. Pp. xv+240 (53 plates). (London: Baillière, Tindall and Cox, 1934.) 16s.

TEXTBOOKS of neuroanatomy are rather apt to become redundant. "Neuroanatomy" by Prof. J. H. Globus was first published in 1915, and we now have the sixth edition. This edition has a method of dissection, and we can rest assured that any student who follows these dissections carefully and discusses the questions asked at the end of each 'assignment' will have a knowledge of the anatomy of the nervous system which will be enduring and at the same time exhaustive.

The book is divided into two parts, the first dealing with the description of the various parts of the brain together with the directions for dissection, etc. The second part consists of the plates, fifty-three in number; these can be detached and after completion by the student replaced in the book by adhesive paper. There are thirty-six figures in part one, all of which are original. The descriptions are extremely lucid and well done, and we congratulate the author on making what is really a very dry and difficult subject to most students into a fascinating and most interesting study.

There is an excellent index.

Nervous Breakdown: its Cause and Cure. By Dr. W. B. Wolfe. Pp. xv+260. (London: George Routledge and Sons, Ltd., 1934.) 7s. 6d. net.

THE question of the nervous breakdown is always with us, and few people realise the amount of time and money lost to the nation each year by people who have personal problems to solve and difficulties to meet that are too much for them. How many people lose heart in the struggle in unhappy homes with individuals they have learnt to hate and end it all in the river or what is nowadays much more comfortable—the gas stove. It is so easy, such a relief from torment. Fifteen people commit suicide in England every day. How many try but do not succeed, and how many consider it, and say they have not the pluck to do it? To all these struggling individuals this book is addressed, and there is no doubt that it will be a great help, but how many are likely to read it? Few, we fear.

The author has shown himself a deep student of human nature and its weaknesses. How many of us are striving to save our 'face'! In his "plain words to parents" there is much worldly wisdom. To learn a funny story and tell it until you make someone laugh is good advice, but does not mean carrying *Punch* under your arm every day as one man used to do until he became an unsufferable bore!

(1) *The Selection of Colour Workers. being a Research into the Practical Methods of measuring the ability to discriminate Fine Shades of Colour* Begun by A. M Hudson Davies and A. Stephenson Completed and described by W. O'D Pierce Edited and with a Preface and a Chapter by Charles S Myers. Pp xi + 134 5s net

(2) *The Case for Vocational Guidance : Three Lectures given under the Heath Clark Bequest to the National Institute of Industrial Psychology* By Angus Macrae Pp vii + 92 3s 6d net

(London Sir Isaac Pitman and Sons, Ltd, 1934)

BOTH these books well exemplify the pioneer research work which is being carried out under the auspices of the National Institute of Industrial Psychology.

(1) The first arose out of a request by a firm of colour printers for a test which would enable them to make selections from their employees for the more responsible positions in the firm From this beginning there followed a prolonged psychological inquiry, resulting in the practical test of colour discrimination here described by members of the staff of the Institute The test has already been proved to have high value in the selection of competent colour workers

(2) The second book is general in character, and relates to the great problem of vocational guidance for boys and girls leaving school As the author sadly remarks, many young people in these days are less concerned with the difficulty of choosing suitable work than with the difficulty of finding work at all Even so, there are many even now who have some choice in the matter, and this short book by Mr Macrae puts the case for systematic guidance in making that choice wisely He does not enter upon the details of the technique of the methods employed by the vocational psychologist He points the way, and supplies bibliographical information for those readers who wish to pursue the subject further. In so doing he has performed a useful service.

Anleitung zu optischen Untersuchungen mit dem Polarisationsmikroskop. Von F Rinne und M Berek Pp viii + 279. (Leipzig: Max Jänecke, 1934) 11 60 gold marks

THIS book appears after the death, on March 12, 1933, of one of the authors, Prof F Rinne The task of completing the work and seeing the manuscript through the press fell to the lot of Prof Berek of Wetzlar, who was taking part in the revision of an earlier book, "Einführung in die kristallographisches Formenlehre", by Prof Rinne, with the idea of strengthening the optical treatment of the subject.

The name of Prof Berek will, of course, be a guarantee that the optical aspect of the subject is well and adequately discussed, and although doubtless some initial study of physical optics would be necessary for a beginner before taking up the volume (the introductory sections are brief in character), the book appears to be a very useful and systematic review of the application of microscopy to the qualitative and quantitative investigation and identification of crystalline substances.

Some of the later sections, on luminescence and on the application of the microphotometer for the measurement of absorption, may be mentioned as bringing the matter well up to date, and Prof. Berek's association with the firm of Leitz will naturally indicate good descriptions of modern resources in apparatus The book is profusely illustrated with diagrams and photographs

L C M

Venereal Disease its Prevention, Symptoms and Treatment By Hugh Wansey Bayly Fifth edition Pp xv + 260 + 3 plates (London Chapman and Hall, Ltd, 1934) 10s. 6d. net

THE first edition of Dr Bayly's "Venereal Disease" appeared in 1919 This is the fifth edition, and it is an improvement on the other editions The author very wisely, we think, points out that a number of competent judges consider that there is a definite increase in the prevalence of neurosyphilis, and not a reduction, as so many hoped there would be Probably the wish was father to the thought It is probable that the ideal treatment for general paralysis is tryparsamide followed by malaria or some other pyrexial treatment and then tryparsamide again The last word on the various fever and arsenical treatments of general paralysis has by no means been said, and in twenty years' time we may find all these present treatments scrapped From the descriptions given, it is rather difficult to see how a differential diagnosis between cerebral syphilis and general paralysis can be made

The book is extremely well laid out and the illustrations and directions for treatment are very good The book is also not too long and diffuse, and is one that we recommend

Handbuch der Spektroscopie. Von Prof H. Kayser und Prof H Konen Band 7. Dritte und letzte Lieferung Pp 751–1473 + xiv. (Leipzig S. Hirzel, 1934) 80 gold marks

THE colossal task of bringing Kayser's standard "Handbuch der Spektroscopie" up to date, which has been undertaken with the assistance of Prof. Konen and other collaborators, is carried forward another stage by the appearance of this, the third and concluding part of vol 7 The publication contains data, complete to July 10, 1933, for the fourteen elements (as usual, in alphabetical order of chemical symbols) from Il to Nb, and the fact that, on the average, fifty pages are required for each element indicates to some extent the imperative need of the practising spectroscopist for such a collection as this With this part are included also an index and an introductory note to the seventh volume.

The general plan and characteristics of the work are so well known that comment is unnecessary: it is sufficient to say that in every respect this issue appears to conform with previous ones The publishers announce that vol. 7, containing 1473 pages and dealing with the elements from argon to niobium, can now be obtained complete at a cost of 132 20 gold marks (bound, 141 gold marks).

Ecology and Rubber-Growing

BROADLY speaking, there are two ways of 'growing' plants useful to man. The first and most obvious is to treat the plant as an agricultural crop, that is, to clear the ground of existing vegetation, prepare it by digging, ploughing, or other treatment, and then to sow or plant the crop, which is kept 'clean weeded'. The second is employed where large tracts of natural vegetation are useful as a whole, or contain useful species, as with pasture grasslands or forest. Here the primary attention required is to see that the regime of exploitation, by the grazing of stock or by felling, is not such as to impoverish the vegetation as a whole, or to favour useless at the expense of useful species. Besides regulating the regime, active interference to these ends is sometimes required.

There are, of course, many crops which are managed by some intermediate method. Thus the primary crop may be sown or planted in the first instance, but other plants may be introduced or allowed to come naturally into the spaces between the crop plants because they are useful in assisting the growth of the main crop plant or in protecting the soil surface. A well-known example is the planting of 'nurse' trees or shrubs, which are eventually removed, between the seedlings or saplings of a young plantation. In all such cases we begin to approach the conditions of natural vegetation, in which more than one species grow in association and the different species present act and react on one another, either favourably, or unfavourably by direct competition for light, food or water. The study of such interactions under the given conditions of habitat is the most important part of what is called plant ecology.

The history of the great rubber-growing industry of the eastern tropics provides an interesting example of a change from the first towards the second of the two methods of treatment. When the first seedlings of *Hevea brasiliensis* were planted commercially in Malaya towards the end of last century, and for several years afterwards, when extremely remunerative results were being obtained, the universal practice, or at any rate the universal ideal, was to keep the plantation 'clean-weeded', and with the cheap labour obtainable this was quite possible on the more successful estates. But after a time it became increasingly clear that the practice was not everywhere desirable. Especially on sloping ground, the bare soil was exposed to erosion by the torrential rains and great damage was done; the soil also deteriorated by the direct action of sun and rain; it often became compact and hard, a result to which the constant trampling of the coolies contributed; and the absence of humus led to its impoverishment in essential mineral food stuffs. Consequently the trees began to suffer and their supply of latex to fall off. 'Clean weeding' began to lose its prestige; and this process was notably aided because, when the slump followed the boom, it was no longer so easy to find the necessary labour. 'Ground cover' began to be planted, at first leguminous plants, which, besides protecting the soil, were expected to increase its combined nitrogen. The legumes, however, were not very successful, largely because their growth under the rubber trees was unsatisfactory.

Then it occurred to someone to try the effect of allowing the natural 'weeds' of the forest to enter and colonise the plantations, which, of course, they had always been trying to do. The results were in many cases beneficial, and the practice became generally adopted. Now, in certain circles, the pendulum has swung to the other extreme, and it is even suggested that a rubber plantation should be treated like a self-regenerating natural forest, with its complex 'stories' of vegetation, and the rubber trees allowed to provide their own successors by sowing their own seed spontaneously! This extreme 'forestry method' of rubber cultivation is far from being generally supported. It is not, for example, the policy of the Rubber Research Institute, though the necessity of 'ground cover' in most cases is recognised. It is obviously true that much more experience is required before we can decide on the relative advantages of such a method of renewing plantations as compared with the established planting and 'budding'.

In a pamphlet recently published, Mr. Haines[*] gives, on the whole, a very fair and interesting review of the situation. He is in favour of what may be described as 'controlled natural ground cover'. Wild plants are allowed to come in, but discriminatingly, and when they become too luxuriant they are to be 'slashed' or otherwise kept down. Different species play different parts under different conditions, and it is impossible to lay down hard and fast rules that some of the natural colonists are 'good' and others 'bad'. All this is just what the ecologist would expect.

One remark of the author (p. 8) is very curious. "Practical planters are . . . advised to *study competition* as evidenced in the development in their fields, and to let Latin names and fine botanical distinctions take second place. Accurate naming of plants must always be helpful in assembling and disseminating information, but a very general classification on obvious features like the rate of growth, habit of growth, both above and below ground, texture of tissues and similar factors is quite adequate for the purpose in hand." But how on earth is a "practical planter", or anyone else, to "study competition" when he does not know the names of the competing species ? Also how will a "very general classification" of the kind described help him here ? It is obvious enough that it does not matter what language the names belong to—Latin, English or Malay—(though the scientific names have well-known advantages), provided the same name is always used for the same species and for that species alone, but names in some language are quite indispensable The planter *must* learn the names of the important species on his estate (or give them names of his own) before he can advance a single step in studying competition or increasing his knowledge in any way of what is going on in his plantations, once he lets in the native plants Naturally, it is not necessary for him to acquire an exhaustive knowledge of the whole flora When he has learned to distinguish the important species, then he can most usefully pay attention to their characters and behaviour under different conditions

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[*] Rubber Research Institute of Malaya. Planting Manual No. 6: The Uses and Control of Natural Undergrowth on Rubber Estates. By W. B. Haines. Pp. iii+23+20 plates. (Kuala Lumpur: Rubber Research Institute of Malaya, 1934.) 1 dollar.

This, of course, is nothing but ecology, and we very much regret to see that, though Mr Haines himself admits (p 1) that "many of the problems which arise regarding natural covers are ecological", Mr B J Eaton in his foreword summarises "the advantages of natural covers" solely in relation to their effect on soil, and writes that "for a study of this aspect of the problem the employment of a Forester or of a Plant Ecologist, as has been suggested in some quarters, is not essential" Well, the rubber industry may survive without such appointments, but that the whole problem is essentially ecological there can be no shadow of doubt The soil problems as such, though an extremely important part of the whole, by no means exhaust the matter, as Mr Haines is clearly aware, witness his constant stress on competition

The general recognition of the fundamental importance of the ecological approach wherever we have to deal with communities of organisms living together is gradually coming, though it is distressingly slow The ecologist is trained to consider the *whole* set of phenomena presented by such communities, and to discover which are of decisive and which of subordinate importance Only when such knowledge has been acquired in any given case can the problem of rational treatment be successfully attacked There are now young ecologists available—as there were not ten years ago—who have had this training, and it remains for the competent authorities to see that their services are employed in tackling the innumerable problems that await rational solution

Specialists who have had a narrower training and very naturally think that 'there's nothing like leather', very often fail to come to grips with the larger aspects of their problems because they envisage them solely from one side Ecologists can sometimes indicate the best solutions as soon as their survey of the field is completed, but very often experiment and specialised work are necessary after the general survey is completed. This is the proper sphere of the specialist, be he plant physiologist, mycologist, entomologist, pedologist or soil chemist Ecologists have now been successfully engaged in the solution of the most various practical problems in New Zealand, in South Africa, in the United States, and elsewhere, but the fields ripe for their work are innumerable, and the proper management of the modern rubber plantation is clearly one of them A. G T

Economy of Transport Overseas

MERCANTILE vessels can be divided into three main classes—passenger ships, combined passenger and cargo ships and purely cargo ships. Of these it is the first class which receives the greatest attention in the public Press ; although the commerce of the world is carried on principally by tramps and freighters, these are seldom in the public eye. Generally speaking, unlike the steam locomotive, which was first used for mineral traffic before its potentialities for passenger traffic had been realised, the steam boat was regarded chiefly as a passenger carrying vessel.

The idea that steam vessels might prove of use for freight carrying, however, was not altogether absent from the minds of the pioneers, and a century and a half ago the oft-forgotten but deserving American inventor John Fitch wrote, "Here is an estimate which I beg leave to make. It takes thirty men to take a boat of thirty tons burthen from New Orleans to the Illinois. Now, I say, if I could be enabled to complete the experiment, I would obligate myself to make a boat of sixty tons burthen which, with engines and all complete, would cost $2,000 As that could work double the time of the men at the oars, it could go half the time, and transport 120 tons in the same time that the other would thirty tons. At the rate now charged this would pay for itself and clear $10,000 whilst one boat could make one trip—and larger boats could be made to greater advantage"

Fitch was a man of wide vision who did not live to see his dreams come true He has, however, as great a claim as anyone to be regarded as the father of the steam passenger boat and the steam cargo boat. But while conceding this, it is true that both in the United States and in Europe, when steamboats came into use, it was passenger traffic which was regarded as the principal source of revenue

The traffic which, perhaps, led to the construction of the first cargo steamers in Europe was the cattle trade between Ireland and England, and just a century ago the *Glasgow Chronicle* referred to the Clyde-built steamer *Irishman* plying between Drogheda and Liverpool, which was capable of carrying 2,000 head of cattle, and was fitted with stalls for horses and horned cattle and pens for pigs, etc, on deck and in the hold. There was certainly need for improvement in this trade, for Joshua Field in his "Diary" of a visit to Liverpool in 1821 said that during a storm in the Irish Sea in September, "6 or 8 Brigs full of horned cattle and pigs were out in it and I believe all came in during the following day having lost more or less of the cattle killed in the hold and pigs either killed on deck or washed overboard One of them lost 60 pigs overboard and one 70 and the captain They came in mostly on their beam ends, the cattle dead and alive being on one side"

Another traffic which gave rise to steam cargo vessels was the carriage of coal from the Tyne to the Thames In 1844, a Tyneside shipbuilder built an iron screw collier with a deadweight capacity of 340 tons, while eight years later Sir Charles Palmer at Jarrow built the larger *John Bowes*, carrying 650 tons The *John Bowes* could make the voyage from Newcastle to London and back in five days and thus "she accomplished an amount of work it would have taken two average-sized sailing-colliers a month to perform". To the success of the *John Bowes* may, to some extent, be attributed the subsequent rapid development of iron shipbuilding on the north-east coast, a district famous for its construction of tramps and freighters. Similar vessels are to-day built in many yards all over the world and from these yards come not only ships ready to carry any form of general merchandise but also others especially designed for the transport of fruit, meat, grain, coal, ore, oil and other commodities. The greater part of the world's mercantile marine is indeed composed mainly of these cargo ships, of which little is heard.

It has been considered worth while to give this brief sketch of the early history of cargo ships because it was with tramps and freighters that Mr. L St. L Pendred was concerned in the most valuable part of his Thomas Lowe Gray Lecture delivered to the Institution of Mechanical Engineers on November 30 (see NATURE, Dec. 8, p. 875). The title of his lecture, "A Survey of Ships and Engines", left him free to touch upon many aspects of shipbuilding and marine engineering, and in the earlier part he pointed out some of the landmarks in steamship history up to the time when improvements in both ships and engines had enabled cargoes to be carried long distances more economically by steam than by sail

Having got thus far, Mr Pendred devoted himself exclusively to cargo steamers. He had been at some pains to obtain from authoritative sources particulars of ships of the last fifty or sixty years, and his lecture contains two tables, prepared, one by Mr T. W Crozier, for many years manager of the Blyth and Tyne Shipbuilding Co, and another by Mr Summers Hunter, giving particulars of merchant steamers engined between 1867 and 1934 by the North-Eastern Marine Engineering Co. With the aid of these tables, Mr Pendred had prepared a series of curves connecting coal consumption, steam pressures, speed, etc. The progress of tramps, however, he summarised as follows. In 1887 a typical tramp was 285 ft. long, with a displacement of 4,840 tons. The working pressure was 160 lb. per sq. in and the speed 9¾ knots In 1896 the length had risen to 325 ft. and the displacement to 7,075 tons. By 1911 the displacement had risen to 10,000 tons, by 1924 to 11,500 tons and by 1928 to 12,380 tons. Boiler pressures had risen to 200 lb per sq. in. or more, and speeds to 13 knots or more Size has much to do with economy of transport, and Fitch was quite right when he said that "larger boats could be made to greater advantage"

In conclusion, Mr Pendred said, "Further economy in cargo ships must be and will be sought. May it not best be found by extension of the known and approved, by higher propeller speeds, higher pressures, higher temperatures, higher piston speeds, better materials making for lighter structures, better under-water form ? These will carry the steam engine forward until, its work well done, it surrenders its place to the internal combustion engine, or to some other prime mover which still lies in the womb of time".

Carriage by sea is the cheapest of all forms of transport, and the reduction in cost during the last century has been remarkable. Even thirty years ago, Sir William White said. "When small vessels were used to transport grain from America the freight was 9*s*. 6*d* per quarter, now it is 9*d*. per quarter from New York in the large cargo-carriers".

Jubilee of the City and Guilds (Engineering) College, London

ON Monday next, February 4, the City and Guilds College, affectionately known to many besides its students as the 'Central', is to celebrate the jubilee of its foundation, the present building having been opened in 1884 It is too near the achievement for us properly to assess the value of the work done in founding and establishing London's and the Empire's premier school of engineering, but it is more than probable that a century hence the historian will regard the movement which led to the establishment of the colleges at Finsbury and South Kensington as outstanding in importance and in the results it produced

From the first, the 'Central' has been characterised by its originality and independence, never were four colleagues so outstanding in this respect as its original professors, Armstrong and Ayrton promoted from Finsbury a year after the establishment of their new building there, Unwin from Coopers Hill and Henrici from University College, London In principle they were in agreement, and each knew they had problems to solve, but each set to work to develop his own department to the best of his ability, and the College developed on these individual lines though also as a whole, and became great perhaps as a consequence

A strong effort was made to make the chemistry course a part of the curriculum of the engineer and to insist on the chemist passing through a comprehensive course in mathematics, physics and the elements of engineering It proved, however, that as a whole the engineers did not want to learn chemistry, chiefly perhaps because the subject never appealed to their mentality, since the tendency of the engineer is to construct and not to think or seek hidden meanings It is of significance in this connexion that scarcely half a dozen of the Centralian engineers have distinguished themselves in chemical engineering, whereas the Centralian chemists, owing in part to their engineering training, have been uniformly successful as pioneers in developing the newer industries. It is still a fact that chemists have to learn engineering and become chemical engineers in order to take part in the enormous developments in chemical industry, and the lack of such trained engineers in Britain as compared with their superabundance in Germany and America has been definitely a handicap.

There is no need to record here how the College has passed from success to success; after the first few years, it was always full with students carefully selected by an entrance examination which grew increasingly exacting. The rapidly developing electrical industry was manned each year by new batches of Centralians imbued with Ayrton's zeal and enthusiasm, and civil and mechanical engineering positions at home and abroad were increasingly filled by Centralians loyal to the Unwin thoroughness Time, alas, brought changes in the professoriate, Mather succeeded Ayrton, Klugh followed Henrici, Dalby came from Finsbury on Unwin's retirement, whilst the Chemical Department was closed when the 'Central' was merged with the Imperial College of Science and Technology, leading to the retirement of Armstrong, who is the only survivor of the four great original founders

So far, the early development of the College has been emphasised and the birth of its traditions, which few will be unwise enough to minimise For the new student tradition must mean much; it is up to him to be worthy of it as Kipling says, "Of one muster all of us, keen in his vocation", whilst, in consequence of the tradition to produce highly trained, reflective, inventive graduates, employers have sought to obtain the 'Central' men as they graduated

Perhaps the first break in the old order came with the inclusion of the 'Central' as a school of the University of London in the Faculty of Engineering in 1899 and the attachment of the University examination and degree in engineering to the diploma of A C.G.I.

To-day the City and Guilds College has its own governing committee, or delegacy, within the organisation of the Imperial College. Its courses are essentially engineering; the number of departments has expanded. There is more specialism, and a number of eminent and devoted professors are giving of their best to training the men so urgently needed for Britain to hold its own in the intense struggle for industrial supremacy. In some ways the requirements are other, more specialised than fifty years ago, in other ways, the need is still the same for men of broad outlook, trained to think and create rather than to memorise and to imitate. The influence of the great teacher, of the man of genius, independence and vigour, is still as great on the student in his most impressionable age, and the College will be wise to select and retain such, be they young or old, whatever may be the cost. Countless biographies of successful men testify to this influence of their teachers on them, prevailing throughout their lives.

The 'Central' has done a great work; it has been well and unselfishly served in the past, it will do so much in the future.

E F. A.

Manufacture of 'Colloidal' Fuel

SINCE 1879, numerous attempts have been made to produce a suitable mechanical mixture of coal and oil that would be capable of retaining the coal particles in suspension for a sufficiently long period and at such temperatures as would be likely to obtain in normal working conditions, where such fuels could be used.

Fairly successful attempts were made in 1918 on the U.S. patrol ship *Gem*, using a blend of 67·8 per cent oil and 31·2 per cent coal dust. More recently, great prominence has been given to this question as a result of experiments made on the Cunarder, S.S. *Scythia*, using a mixture of 60 per cent of oil and 40 per cent fine coal.

Despite these tests, progress in the development of a 'colloidal' fuel has been very slow. This is due to two causes:—first, the difficulty experienced in keeping the mixture in a stable condition where it had to be stored for any lengthy period before use; and secondly, the high cost of pulverising dry coal to a sufficient degree of fineness to make a suitable and stable liquid emulsion.

The former difficulty can be readily appreciated when it is realised that the specific gravities of coal and oil are 1·3 and 0·9 respectively. Various attempts have been made to keep the coal particles in suspension by the addition of fixateurs (such as rosin, paraffin wax, etc.) or by the addition of 'peptising' fluids which tend to increase flotation by splitting up the particles of coal into still smaller particles. While the fixateurs have been more or less successful in increasing the period of suspension, the cost of peptising fluids makes their general use prohibitive.

From the results of a demonstration given by Messrs. Wyndhams Liquid Coal Co., Ltd., at their Cardiff works on January 23, it would seem that their engineer, Mr. Stephen Wyndham, has recently made great progress in overcoming both of the difficulties referred to. In his new plant, he has eliminated the costly process of dry coal pulverisation by mixing the fine coal as received from the colliery with an equal amount of heavy oil and then passing the coal-oil mixture through a series of rolls until a fineness of 99 per cent through a 200 I.M.M. mesh is obtained for the coal particles. This degree of fineness together with the aeration of the mixture which takes place in passing it through the mixer and between the mixer and the successive series of rolls, seems to give a very stable mixture which will retain the coal particles in suspension for at least four months under normal working conditions.

The plant is very simple in construction and no chemical processes are involved. The class of coal used is that known as 'duff' (namely, coal less than $\frac{3}{16}$ in. in diameter) and is fed from an overhead hopper through a worm screw into the rotating mixture where it meets an oil spray, forming a paste of coal and oil. The predetermined quantities of coal and oil forming this paste are automatically regulated in their entry to the mixer, which is fitted with a spiral worm cast on the inside and passing from top to bottom of its 6 ft. length. Although only 18 in. in diameter, it is capable, when working continuously for six days a week, of producing 100 tons of colloidal fuel.

The paste passing from the mixer is pumped to a pair of rolls 8/1000 in. apart, rotating in opposite directions at variable speeds of 3 to 1. It is then pumped to the second set of rolls, which are 4/1000 in. apart, and so on down to the fourth or sixth set, according to the degree of fineness required to produce stability for any particular class of coal.

The cost of one 100 ton per week plant is approximately £1,000. Very little manual labour is required to operate it and the maintenance charges ought to be low, as the principle of wet milling is used throughout the process.

In burning the oil underneath a steam boiler, the fuel is pre-heated to about 250° F., at a pressure of 15–20 lb. per square inch, and the air is maintained at a pressure of 2 lb. In the demonstration test, this gave a clear smokeless flame, without a trace of coking at the burner tip.

It would appear that we are at last within sight of the solution of a problem which has taxed the ingenuity of engineers for at least half a century.

Obituary

SIR E. A. WALLIS BUDGE

IN the course of the year 1934, Egyptology had to record a heavier loss of life amongst its leaders than has occurred in any other single year of its century odd of history. Five of the seven who died were Englishmen; the last was Sir Wallis Budge, for more than thirty years keeper of Egyptian and Assyrian antiquities in the British Museum, and one of the two most widely known Egyptologists that Great Britain has produced. The characteristics that gave him the unique position which he held in the public mind were no ordinary gifts, and are perhaps not to be found combined in our own generation.

Ernest Alfred Wallis Budge was born in 1857 of a Cornish Quaker family, to which no doubt he owed that abiding interest in the study of religions which was the mainspring of so much of his work In the man himself, assisted perhaps by the not easy circumstances of his early years, lay a 'power of work' which quite transcended mere industry and was his outstanding characteristic and the envy of those who served him As a boy, it attracted the attention of his superiors and eventually won him the backing of W E. Gladstone At Cambridge, it brought him University prizes and an unusually wide and thorough knowledge of Semitic languages with which to start his official career in the British Museum

The bare record of Budge's exceptionally early promotion to the full responsibility of keepership, followed by nearly two columns of "Publications", are still to be read in the current "Who's Who" But no mention is made there of the period during his assistantship, when, after the retirement of Renouf, the responsibility for the Department was his, with out the privileges of the appropriate office In two fat volumes, "By Nile and Tigris" (published 1920), parts at least of the adventurous life at home and abroad, which lay behind those dates and titles, are to be found. It is a story of vital and impressive contacts with the great pioneers of Egyptian and Assyrian studies, and of lasting gratitude to early masters, of missions on the Trustees' behalf to Egypt and Mesopotamia, covering a period of nearly thirty years; of the famous action for slander—*Rassam v Budge*, of which the extensive account from the issue of NATURE for August 10, 1893, emphasises the national interest at stake and more than vindicates Budge's part in the case This unofficial account of a scholar–civil servant's official career was as near as its author could permit himself to come to an autobiography, but we may guess that it tells only half the tale, and no one who reads it can escape the regret that we shall never know the rest

Neither the long tenure of his office nor his massive learning could by themselves have made Budge the public figure that he was; though both contributed to his fame It was the vigour and quality of his personality that endeared him and 'made his name to live' on the lips of as many thousands as there were individuals who came to blows with him professionally. But no man of his virility could fail to make enemies; nor could one of his positiveness easily escape criticism, some of it deserved. His worst enemies would not deny that he was possessed of prodigious learning; but inaccuracy in its setting forth rendered him liable to endless attack That charge was not always a just one. His most important scientific work, which naturally was that most criticised by his colleagues, was the edition of texts, generally of considerable length, in many languages—Assyrian, Egyptian (Hieroglyphic and Hieratic), Coptic, Ethiopic, Syriac. It was a principle with him that in editing ancient authors his business was simply to present their text in a printed form which would be accessible to modern scholars. The correction of mistakes in the text, if indeed they were mistakes, was a secondary and later task with which he was not concerned. As a result, he sometimes received the censure which should have been addressed to the original scribe of the manuscript in question There was something to be said on both sides of the argument, but however strong the attack, Budge's claim to be accounted among the great Oriental scholars of the last fifty years will grow rather than fail as personal considerations automatically die, leaving the impressive series of his editions of primary texts to speak for themselves

Then again, the extraordinary number and size of the books which Budge turned out, the majority necessarily of a popular or semi-popular nature—while a matter of pride to himself—was often counted against his reputation But in truth, it was a part of his greatness that he knew how to do what no other Egyptologist in Great Britain could do by writing, namely, to bring his subject within the reach of the ordinary reading public Nor were his books a mere popularisation of that side of Egyptian studies which might be supposed to have a natural attraction for the man in the street Any teacher of the subject, and still more any museum official familiar with the endless stream of inquiry on matters Egyptian which pours through the British Museum, is well aware that almost all stock questions relating to the history, customs or antiquities of Ancient Egypt can be most expeditiously answered by referring the inquirer to one or another of Budge's handbooks. The secret of his success lay, of course, in his Museum experience Budge was above all things a devoted public servant, and after he had retired from the Museum and until the last, he remained as jealous for the authority and privileges of the Trustees, the representatives of the public, as he had been loyal to their interests during his service

The tradition of scholarly research and authoritative learning in the subjects with which they dealt stood high among the officials of the British Museum when Budge entered it, but he was one of the first to bring that wealth of knowledge within the reach of the general public, even though, for various reasons, some of the methods he used would not now be considered good museum technique, or even effective for the purpose he sought. But it was of paramount importance that he should have been so fully conscious that the antiquities under his charge were the property of the nation, and that it was therefore his duty, first to take proper care of these antiquities, and secondly to make them as much available to the nation as was possible. He had his own clear ideas as to the manner in which both purposes should be achieved; and both brought him into conflict with authority. But he knew that in principle he was right, and he was proud to think that his knighthood was the reward not of his contribution to scholarship, nor of his success as a populariser of a branch of learning, but to the faithful performance of his stewardship. It was from his determination to serve the public that he learned what they wanted —or at least, what they thought they wanted—and gave it to them so successfully in his books and in the galleries under his charge.

S. R. K. GLANVILLE.

SIR MAURICE CRAIG

PSYCHIATRY has suffered a grievous loss by the death on January 6 of Sir Maurice Craig, consulting physician in psychological medicine to Guy's Hospital, and consulting neurologist to the Ministry of Pensions Born in 1866, he received his education at Bedford Grammar School and Caius College, Cambridge. He was early interested in mental disorders, and was one of the many distinguished men who have gained the Gaskell Gold Medal of the Royal Medico Psychological Association.

For more than fifteen years, Craig was a resident physician at Bethlem Royal Hospital, years in which he gained a very wide experience in psychiatry, and in the teaching of the subject to students From 1907 Craig confined himself to consulting work, and built up a very extensive practice He delivered the Bradshaw Lecture at the Royal College of Physicians on "Mental Symptoms in Physical Disease" in 1922, and the Maudsley Lecture on "Some Aspects of Education and Training in Relation to Mental Disorder" in the same year In addition to numerous articles in medical journals, Craig published a book on "Nerve Exhaustion" which was much discussed on its appearance In 1905 the first edition of his well-known textbook on psychological medicine appeared, after exhausting three editions, the book was revised and rewritten in co-operation with Dr. Thomas Beaton and republished as the fourth edition in 1926

During the War, Craig was a valued adviser on the care and treatment of nervous and mental disorders among officers and soldiers, and afterwards became consulting neurologist to the Ministry of Pensions, and a member of the War Office Committee on shell shock. He received the C B E in 1919, and the honour of knighthood in 1921

Sir Maurice Craig developed a profound interest in the early evidences of mental disease, and throughout his teaching life insisted on the importance of early symptoms. During the years of his consulting work, he became increasingly concerned in what are known as the psychoneuroses and neuroses He was an enthusiastic and hard-working chairman of the medical committee of the Cassel Hospital at Penshurst, and chairman of the National Council for Mental Hygiene up to the time of his death.

Sir Maurice Craig enjoyed a very wide esteem and popularity among his professional brethren. He was made a governor of the Royal Hospitals of Bethlem and Bridewell; he became the president of the Section of Psychiatry, Royal Society of Medicine, and president of the Section for Mental Diseases at the centenary meeting of the British Medical Association in 1932 He was a vice-president of the International Committee for Mental Hygiene. His many appointments reflect his scientific interests, and his universal popularity.

It is impossible to write of Sir Maurice Craig without remembering his charm of manner, his delightful presence and popularity. He was ever ready to help and encourage a younger colleague, and was tireless in his devotion to his patients. Yet he could be quite fearless and outspoken in debate or criticism. His contribution to psychiatry may be summarised by his constant insistence on the importance of early symptoms in every form of mental disease, and the urgent need of early treatment; by his leadership in making psychiatry a part of general medicine, and freeing it as far as possible from legal restrictions; by the stimulus he has given to improving the education of medical students, practitioners and the general public in matters of mental health and hygiene Lastly, Craig has focused a keen scientific inquiry on the place taken by fatigue in the etiology of mental disease His death will be deplored by a very wide circle of scientific men

THE REV S A. McDOWALL

THE death on January 13 of the Rev S A. McDowall, chaplain and senior science master at Winchester College, will be felt as a deep personal loss by many Wykehamists and a wide circle of friends.

Stewart McDowall went up to Trinity College, Cambridge, from St Paul's School and obtained first classes in both parts of the Natural Sciences Tripos. He became a demonstrator in the Biological Laboratory and assistant superintendent of the Museum of Zoology at Cambridge. In 1905 he joined the staff of the Christian College at Madras as temporary professor of zoology, and a year later was appointed an assistant master at Winchester College In 1908 he was ordained, and in 1915 became one of the College chaplains In the same year he published the first of a number of works on science, philosophy and religion "Evolution and the Spiritual Life" was the first expression of his beliefs that evolution was the method by which God had chosen progressively to create free beings, and that science had great gifts to bring to the service of the Christian world

McDowall was a select preacher at Oxford 1916, at Cambridge 1920, and Hulsean lecturer 1923–24. "Evolution and the Doctrine of the Trinity" appeared in 1919, and the Hulsean Lectures were published as "Evolution, Knowledge and Revelation" Meanwhile, he had been appointed senior science master at Winchester College in 1918, and since that time had much to do with the development of the science teaching both of science specialists and of a general science course which is taken by the whole of the upper part of the school.

McDowall held vigorously the view that every citizen should have sufficient training to appreciate the scientific problems which only the highly specialised technician can be expected to solve, and that all should have some acquaintance with the history of man's growing control over his environment, particularly as it has been attained by scientific methods. During the last year of a boy's school life, he aimed at introducing to him the facts and theories of modern biology in their bearing on the life of a civilised community. His views on this subject were incorporated in his last book, "Biology and Mankind", published in 1931.

For many years McDowall was curator of the College museum and president of the Natural History Society, of which the biennial reports show the wide range of interests which he inspired in his young friends. To his psychological knowledge and insight, and to his sympathy with differing minds, Dr. William Brown has borne eloquent witness in *The Times*. He was a man of great personal charm and a brilliant conversationalist. His intellectual and æsthetic interests were very wide and led him to seek new experiences and to encourage others to share them. Successive generations of Wykehamists testify to the way in which he stimulated the development of their minds by his own enthusiasm for life.

Mr. Kenneth F. Armstrong

The death of Kenneth Armstrong on January 3, at twenty-five years of age, while on a visit to the Austrian Tyrol with another young and promising Oxford graduate, John Howard, who was an old schoolfellow, is a grievous tragedy. While ski-ing, they encountered an avalanche which seems to have swept Howard to his death, and it appears that Armstrong, in his endeavour to recover his companion, fell into a ravine, being killed as the result of crashing on a rock.

Armstrong was the son of Dr. E. F. Armstrong and the grandson of Prof. H. E. Armstrong. His death is a personal shock to everyone who knew him, and it is regrettable that chemistry should be deprived of the contribution to its progress so clearly destined to come from his labours. There can be no doubt that, had he lived, he would have done full credit to his scientific ancestry.

Armstrong received his early education at Oundle School, whence he went to Magdalen College, Oxford, in 1927, having been awarded a demyship there. He gained a first class in the Honour School of Chemistry at Oxford in 1931. After graduating, he was awarded a Julia Henry scholarship and proceeded to Harvard University and commenced work on chlorophyll problems with Prof. J. B. Conant. In the two years spent there, he made a valuable advance in this difficult field, and part of the work has been published in the *Journal of the American Chemical Society*. Armstrong's extensive knowledge of this subject enabled him to contribute a lucid article on present-day knowledge of chlorophyll to *Chemistry and Industry*.

Soon after his return to Oxford in 1933, Armstrong was elected to a Harmsworth senior scholarship at Merton College and was quickly at work on several problems of his own choice. Among these were: the nature of the colouring matter of the red moth; the identity of the glucoside in the Japanese laurel (*Aucubine*); and the configuration of the cyclic polyalcohols, particularly quebrachol. Recently, in collaboration with Prof. R. Robinson, some work on the oxidation effects of selenium dioxide was published. Armstrong recently collaborated with his father in producing a new edition of the well-known books on the simple carbohydrates and the glycosides.

His friends will ever remember with respect and admiration Armstrong's unfailing kindliness on all occasions. His lamented death deprives the Oxford school of organic chemistry of one of the most notable of the younger generation of research students.

Dr. Eleanor Hull

We regret to record the death of Miss Eleanor Henrietta Hull, folklorist and Erse scholar, which took place at the age of seventy-five years, on January 14, at Wimbledon.

Miss Hull was the daughter of Prof. Edward Hull, and was educated at Alexandra College and the Royal College of Science, Dublin. She studied Celtic and allied subjects under Pedersen, Kuno Meyer and R. Flower. An enthusiast for the study of Irish history and letters, she added sound scholarship to the movement for the revival of Erse and the rekindling of pride in Irish tradition. Apart from her own literary work, this took practical form in the foundation in 1899, with the assistance of Prof. York Powell, of the Irish Texts Society. As honorary secretary of the Society she enlisted the services of the foremost Erse scholars of the day, and was largely responsible for the publication of a number of valuable and important early Irish manuscripts. Miss Hull was at one time secretary of the Royal Asiatic Society. She had served as president of the Irish Literary Society of London and was a member of the Council of the Folklore Society.

Among her contributions to Irish studies her work on the Cuchulain Saga (1898) will always hold first place; but as a folklorist her "Folklore of the British Isles" (1928), in bringing some sort of system and order to the treatment of a mass of somewhat chaotic material, runs it close. Among other works worthy of note were her "Pagan Ireland and Early Christian Ireland" (1904), "A Text-Book of Irish Literature" (1906–7), "Cuchulain, the Hound of Ulster" (1909), and a "History of Ireland and Her People" (1926, 1931) in two volumes.

We regret to announce the death of Arthur Lionel Pedder, on December 15, at the age of sixty-six years. He was mathematical tutor at Magdalen College, Oxford, from 1891 until 1925. He went to the College as a demy in 1886, and was elected fellow in 1894. Pedder was a very good teacher and was remembered with gratitude and affection by his pupils. He was one of the old-fashioned people who valued the educational training given by the curriculum and examinations of the old mathematical school as one of the best preparations for after-life; and was quite out of sympathy with the new system which, in his opinion, was of little or no use, except for those who intended to be professional mathematicians.

We regret to announce the following deaths:

Mr. F. J. Blight, fellow of the Royal Society of Edinburgh and formerly chairman and managing director of Messrs. Charles Griffin and Co., Ltd., publishers of many scientific and technical works, on January 27, aged seventy-six years.

Dr. Michael Grabham, author of numerous books and papers on the natural history of Madeira, where he had lived for some seventy years, on January 28, aged ninety-five years.

News and Views

Prof. Arthur H Compton

THE Guthrie lecture of the Physical Society is being delivered this year at the Imperial College of Science and Technology, South Kensington, on February 1, by Prof Arthur H Compton, of the University of Chicago Prof Compton, who is at present Eastman visiting professor at the University of Oxford, is perhaps best known for his discoveries of the laws of interaction between radiation and free electrons, and for the associated effect, called after him, which results in a modification in the quality of a beam of monochromatic radiation such as X-rays on passing through matter It was for these discoveries that he was awarded the Nobel Prize for physics in 1927 He is also one of the leading authorities on X-rays and the author of one of the finest books on this subject In recent years, Prof. Compton has turned his attention mainly to the investigation of the cosmic rays, those mysterious and exceedingly penetrating radiations which come into the earth's atmosphere from outside. In this connexion he has organised twelve expeditions, with the collaboration of about a hundred physicists, which have made a cosmic ray survey of the globe He also initiated, and was scientific director of, the balloon flight of Settle and Fordney in November 1933 for investigating conditions in the upper atmosphere, which achieved what still remains the official world's record altitude of 11 8 miles

Prof. Arthur Lapworth, F.R.S.

PROF ARTHUR LAPWORTH, who is Sir Samuel Hall professor of chemistry at the University of Manchester and director of the chemical laboratories, is retiring in September next. Prof. Lapworth joined the staff of the University of Manchester in 1909 as senior lecturer in chemistry, on vacating his lectureship at Goldsmiths' College, London He was appointed professor of organic chemistry in 1913, and Sir Samuel Hall professor and director of the laboratories in 1922 He was appointed pro-vice-chancellor in February 1933, and it is a disappointment to the University that his health has not allowed him to exercise the functions of this office during the last few months During his time at Manchester, Prof Lapworth has published work in a number of branches of pure organic and physical organic chemistry; he will be remembered for his investigation of the terpenes, his work on certain natural products carried out in association with the Oil and Fats Committee of the Food Investigation Board, and especially for his studies on reaction mechanism and molecular reactivity, which led to the initiation of the now famous 'electronic' theory of organic reactions. He has been awarded honorary degrees by the Universities of Birmingham and St. Andrews, and received the Davy Medal of the Royal Society in 1931. His retirement will be a source of deep regret to his many colleagues and students.

Centenary of Friedrich Winnecke, 1835–97

ON February 5 occurs the centenary of the birth of the distinguished German astronomer, Friedrich August Theodor Winnecke, who at the early age of twenty-eight years was elected an associate of the Royal Astronomical Society, and was for a time the vice-director of Pulkova Observatory The son of a pastor, Winnecke was born in a village in Hanover, and after leaving school studied at Göttingen and Berlin, coming under the influence of both Gauss and Encke At the age of twenty-one years he became an assistant at Bonn to Argelander, who was then engaged on his great star maps A visit by Wilhelm Struve to Bonn led to Winnecke in 1858 becoming a member of the staff at Pulkova, where he worked under both Wilhelm and Otto Struve, until in 1865 he was overtaken by severe mental illness During those years he had observed the comets of 1856 and 1862, watched in Spain the total solar eclipse of 1860, made notable observations on Mars and compiled the first Pulkova General Catalogue of Stars When he regained his health, he settled at Carlsruhe, and after the conclusion of the Franco German war was appointed to the chair of astronomy at Strasbourg and charged with the task of erecting an observatory. He spent some ten years there, when to the great loss of astronomical science he was attacked by melancholia and from that time until his death at Bonn on December 2, 1897, the cloud which settled on his mind never lifted He had been a frequent contributor to German, English and Russian astronomical publications, and was widely known as a great teacher of practical astronomy.

Anniversary of Prof. F. Haber's Death

TUESDAY, January 29, was the anniversary of the death in Switzerland of Prof. Fritz Haber, and a memorial ceremony at which certain of his distinguished German scientific friends were to speak had been arranged by the Kaiser Wilhelm-Gesellschaft in co-operation with the German Chemical Society and the German Physical Society It was to have been held in the Harnackhaus, than which no more appropriate surroundings could have been found, and a pleasant impression had been made among Haber's friends that these three great German scientific societies were prepared to honour so soon the memory of one of their greatest members, though he had been among those men of science who had given up their positions through the political changes in Germany The Prussian Minister of Education, however, in a letter dated January 17, addressed to the rectors and teaching staff of the universities, has expressed surprise and disapproval of this proposed memorial According to this circular, Prof. Haber was dismissed on October 1, 1933, on account of a proposal which could only be regarded as showing his opposition to the measures taken by the National-Socialistic State. The ceremony seemed to the

Minister to constitute a challenge to the State, particularly since such memorials were to be held in honour only of the 'very greatest' Germans. The circular consequently concludes by forbidding all officials and all other members of staffs or institutions under the Ministry from attending the ceremony. It is difficult for scientific workers outside Germany to understand why a Minister of State should prohibit the commemoration of the great services rendered to that country and to the world by Haber, or what must be the feelings of the members of the societies concerned with the organisation of the proposed ceremony. Chemists and physicists throughout the scientific world acknowledge Haber's work as epoch-making, and Germany should be proud to cherish his memory. Truly in his case the Prussian Minister of Education now makes it clear that, officially, "A prophet is not without honour, save in his own country and in his own house".

Intensive Farming and Security of Tenure

THE Metropolitan Water Board is promoting a Bill in the present session of Parliament to acquire the Holly Lodge Farm, Walton-on-Thames, owned by Mr. A. F. Secrett, for the purpose of making a storage reservoir. Mr. Secrett is well known in the horticultural world as one of the leading growers of vegetable produce for market. He has been particularly prominent in developing the growing of early vegetables, winter salading, etc., hither to almost wholly supplied by French and other continental growers, and by his willingness to impart his knowledge of the management of these special crops, he has contributed more than anyone else to provide the home market with these products. The farm consists of 187 acres, of which 165 are now in intensive cultivation. One acre is under glass, three acres are under frames for early lettuce, etc. The seakale beds, traversed by an underground hot water system, extend to about ⅛ acre. The whole farm has been redrained so as to lower the winter water table 4–6 ft. below the surface. The irrigation system, with its own well and pumps, covers 125 acres, requiring 2½ miles of pipes. No other agricultural enterprise in Great Britain of this magnitude can show an equal intensity of cultivation, for example, a capitalisation of £81 per acre (exclusive of land), an output of £142 per acre, a wage bill of £62 per acre. No less than 10,000 tons of dung have been brought on to the farm for this year. It is noteworthy that Mr. Secrett, as a pioneer in his special business, has always been willing to instruct others; at the present time he has taken on fourteen young men to gain experience of his methods. They pay no premium and receive the ordinary wages; once each week Mr. Secrett lectures to them and explains his procedure.

THE destruction of this business could not adequately be met by even the high compensation which Mr. Secrett might obtain. The site is a special one selected by Mr. Secrett after long search; it would be extremely difficult, indeed it might be impossible, to obtain an equivalent piece of land, which even then would require some years to equip and bring to a similar pitch of fertility. Doubtless very careful consideration has been given to the selection of this site for a reservoir, but it is difficult to suppose that no alternative exists. Mr. Secrett's farm stands pre-eminent as an example of the productive enterprise which the Government's agricultural policy is trying to foster, and of exceptional employment upon the land, under nothing short of absolute necessity should it be allowed to be submerged. Had the farm been a factory employing a hundred workmen and engaged in some new process, the Metropolitan Water Board would have thought twice about disturbing it. Yet it is a simple matter to rebuild a factory compared with the difficulty of finding a site and the time required to bring it into condition in order to replace the outfit represented by Holly Lodge Farm.

Aboriginal Reserves in Australia

THE attention of the public in Australia has again been directed to the urgent problem of the aborigines and their reserves. On this occasion the method employed to secure its consideration has been unique. According to a dispatch from the Melbourne correspondent of *The Times*, which appeared in the issue of January 24, a deputation of ten full-blooded aborigines waited upon Mr. Paterson, the Minister of the Interior, to urge, among other matters, the establishment of a Federal Department of Native Affairs, under a sympathetic administrator such as Sir Hubert Murray, the present Lieut.-Governor of Papua, and the institution of an advisory council, which would include social, anthropological, medical and educational experts. The spokesman of the deputation directed attention to the serious economic situation now arising among the aborigines. He pointed out that they are being driven into barren wastes in which it is impossible for them to live. He also pledged the aborigines as Commonwealth citizens, believing that the British Empire stands for justice, order and freedom, to maintain their heritage handed down to them by the Creator, but suggesting in what followed that present conditions were not favourable to that end. This is a somewhat surprising, but none the less significant, indication of recent developments in the movement for the improvement of the lot of the aborigines. It is probable, and, in fact, certain that the Australian public generally is not very fully informed of conditions of life among the aborigines. The mere size of the reserves has tended to obscure the relation to the area requisite for subsistence to the mode of subsistence. It is not realised that a considerable range of land is needed for the support of even small groups of food gatherers such as those found among the Australian aborigines. The formation of a Department of Aboriginal Affairs, of which the consideration is promised by Mr. Paterson at the next conference of Premiers, would ensure a more carefully reasoned control of aboriginal territory in relation to their needs and mode of life.

Ancient Greece and Modern Civilisation

IN his Friday evening discourse delivered at the Royal Institution on January 25, Sir Richard Livingstone discussed the relation of modern civilisation to ancient Greece. Starting in a world where men believed that Zeus made thunder and that the sun and moon were gods, the Greeks originated science. Their actual scientific and philosophic achievement was remarkable (witness Aristarchus's discovery of the heliocentric system, the anticipation of modern thought in Anaximander's notion that men originate from animals of a different species, and Democritus's atomic thory). But even more remarkable is the grasp on the ideal of science shown in such sayings as "Thought is the supreme excellence of men and wisdom consists in saying what is true and acting according to Nature, listening to her" (Heraclitus), and "It is a sin that Reason should be the subject or servant of anyone, its place is to be ruler of all" (Plato). Further, they grasped the idea of a civilisation based on the development of the useful arts. This appears in the myth of Prometheus as expounded by Aeschylus, in the "Antigone" and in many other passages in Greek literature. In this sense the Greeks were the creators of the characteristic spirit of modern civilisation. They grasped the ideal of science as completely as any of their successors. We have carried scientific discovery and technology to heights of which they never dreamed. But they formed a clearer and perhaps higher conception than we of the life which men should lead against the background of material civilisation. They can correct our civilisation not only by the example of an existence, of which Goethe said that of all men the Greeks had dreamed the dream of life best, but also by reminding us that life is essentially a human problem and that ethics and political science are as fascinating as, and even more important than, physical science.

Radio Research

A DISCOVERY of great theoretical and practical significance in radio transmission was made last year. Listeners to foreign stations have, for some time past, noted that their reception was sometimes marred by a faint background of sound apparently made by a high-power long-wave station. At first, lack of selectivity in the receiver and possibly cross modulation were suspected. According to Prof. E. V. Appleton, in a paper in the *Electrician* of January 25, the interference is due to a cross modulation effect in one of the ionised layers in the atmosphere. The effect was first noticed in connexion with the powerful Luxembourg station, so it is generally called the Luxembourg effect. Recently amateurs belonging to the Radio Research League have shown that the phenomenon is also produced by the high-power stations at Droitwich and Athlone. Apparently a long-wave station of this type can impress the waves it produces on the ionised layer in its vicinity. If waves of another wave length are reflected there, they acquire the modulation in question during the process of reflection. The present tendency of increasing the power of long-wave senders makes this phenomenon of practical importance. It brings about a type of interference over which the radio engineer has no control. Prof. Appleton comments also on the propagation of ultra-short waves (less than 8 metres). They are of importance because of their possible use in television. Apparently there is no acceptable evidence that 'round the world' communication will ever be possible with such short wavelengths. The lowest possible wave-length appears to be determined by the finite value of the electrification in the upper atmosphere.

International Comparison of Radio Frequency Standards

THE technique of modern radio communication demands a very high degree of precision in the control and measurement of frequency. Considerable attention is therefore devoted by the more important national administrations to the development and maintenance of accurate frequency standards. In Great Britain one of the standards installed at the National Physical Laboratory provides a frequency of 1,000 cycles per second, the stability of which is better than one part in ten million. In order that this standard may be compared with those of other countries, the derived alternating current is used to modulate the carrier wave of a radio transmitting station. At the distant receiving station the modulation is extracted from the arriving signal and its frequency is compared with that of the local standard. In this manner frequency comparison measurements may be carried out simultaneously in different countries. Under the auspices of the Union Radio Scientifique Internationale, and with the co-operation of the British Broadcasting Corporation, such an international frequency comparison will be carried out during the night of March 12–13 next. On this occasion, the output from the frequency standard at the N.P.L. will be employed to modulate waves from the Droitwich, Scottish National and Scottish Regional stations of the B.B.C., simultaneously with the frequency of 1,000 cycles per second, for a period of about an hour and a half. The object of using several stations is to enable observations to be made on two or three carrier frequencies simultaneously, so that the effect of fading phenomena on frequency stability may be studied. On the same night a special emission of a constant frequency of five million cycles per second will be made from the U.S. Bureau of Standards, Washington, of sufficient intensity for satisfactory reception in Europe. Persons and organisations desirous of making use of any of these emissions may obtain further details from Dr. E. H. Rayner, president of Commission I of the U.R.S.I., at the National Physical Laboratory, Teddington, Middlesex.

Protection of Wild Animals in India

IT is a welcome sign for the welfare of the wild fauna of India that the editor of the *Indian Forester* (November 1934) should support whole-heartedly F. W. Champion's appeal in the *Journal of the Bombay Natural History Society* of April. Forestry officers possess great power of determining the fate of the inhabitants of the areas under their control, and while complaints have been made here and there of excessive shooting on the part of the officers themselves, in most areas their influence tells for the preservation of forest animals. Fluctuations in numbers must be expected, and in the United Provinces, while tigers appear to have increased in numbers, marked decreases seem to have taken place amongst nilgai, kakar, wild dog and black buck. The decreases are attributed to serious floods and rinderpest epidemics, and these may be temporary, but the decrease of wild dogs is due to the large reward paid for their destruction. It is unfortunate that the author speaks with two voices about the relative abundance of game at the present day.

Gradual Decrease of Game in Reserved Forests

IN the earlier part of his article, Mr Champion gives as his definite conclusion that "taken as a whole the head of game shot recently has generally shown no marked decrease, except in the mountain reserved forests, where control is not so easy", and again "the impression of senior forest officers is that . . the game in the United Provinces Reserved Forests as a whole has not markedly decreased during the last 25 years, except in the high hill forests". But before concluding his article he reconsiders the matter, and the result is by no means so encouraging. "I am not so certain as I was that the head of game inside the United Provinces Reserved Forests is not decreasing. Although still a good place for animals in 1931, I would estimate that there had been at least a 25 per cent decrease in nearly all species during the previous decade." The decrease he puts down to the ease with which shooting can now be prosecuted owing to motor cars, and the destruction of game in areas outside the forests, which results in a smaller influx into the forests, and along with this the greater damage done to animals straying from the forests. Although the position in the reserved forests is not so serious as in outlying areas, it appears to have definitely deteriorated, and in view of this it is unfortunate that the earlier misleading statement was not deleted or modified before the article appeared in print.

Electrical Control of Road Traffic by Vehicle Actuation

THE control of road traffic by means of vehicle-actuated signals is making rapid progress. In a paper read to the Institution of Electrical Engineers on January 24 by Mr. T. P. Preist, the relative merits of the control of road traffic by traffic officers and by time-controlled signals are discussed. The great advantage of using traffic officers is that they are able to take advantage of any useful break in a heavy stream of traffic and so reduce the time interference to a minimum. A drawback is that they are not conspicuous; this could be reduced by mounting them on a raised platform or crow's nest, but even this is not always effective, and a driver in the rear has to deduce the signals from the movements of the vehicles ahead. They also favour unduly horse-drawn vehicles and stragglers. With automatic lamps the signals are highly visible and control the traffic of vehicles before officers could see them from the cross-roads. On the other hand, the system is quite inflexible and may lead to much waste of time. Although railway practice has provided much valuable information to designers of road traffic control, there is a great difference between the fixed path of the railway train and the haphazard paths of the road vehicle. Mr Preist pointed out a useful analogy between the road traffic problem and the problems that arise in telephony. Both arts have to select and control particular paths from the total available and ensure the orderly passage of the chance traffic arriving on those paths. In telephony the 'traffic' is concerned more with areas than with intersections, and future progress of road traffic control will probably lie in this direction.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions at the British Museum (Natural History) is a collection of 910 Coleoptera comprising 197 named species of Carabidæ (Trechinæ) and 257 species of Silphidæ (Bathysciinæ and Catopinæ) received from Dr R. Jeannel, director of the Museum d'Histoire Naturelle of Paris. The main interest of these two groups of beetles is that they include the beetles that inhabit the extensive limestone caverns both of Europe and America. In the course of the ages that have elapsed since their ancestors left the free air and sunlight, various modifications for a cavernicolous habit have been evolved; thus, they have completely lost their eyes, their colour is an almost uniform reddish yellow, their legs have tended to lengthen while their wings have tended to disappear, and in some groups have been entirely lost, and their long isolation as separate colonies has brought about the evolution of distinct species in each different system of caverns. The Department of Mineralogy has received by exchange a portion (4,036 gm.) of a new meteoric stone from Lake Labyrinth in South Australia. A large series of specimens from the Libyan Desert has been collected by Dr L. J. Spencer, keeper of minerals, while on the expedition of the Survey of Egypt to the Sand Sea in December. The object of the expedition was to investigate the origin of the lumps of pure silica-glass found on the surface in the stony or gravel 'streets' between the high (300 ft.) north-south dunes near the border of Italian Cyrenaica. Wind-worn pieces of clear glass were found in abundance over an area of 200 km. × 40 km., the largest lump weighing 16 lb. Many of the pieces had been broken by primitive man and were associated with hundreds of thousands of flakes of glass and quartzite. Querns and grinding stones were frequently found, and at one spot sixty fine palæolithic axes of quartzite, 8–10 in. long, were found. The region must at one time have supported a large population, but now not a living animal or plant is to be seen. Unfortunately, the glass could not be traced to any source. Another kind of silica-glass was found in the form of lightning-tubes or fulgurites, made by the fusion of the sand when the dunes were struck by lightning. These are paper-thin tubes ¼ in. to one inch in diameter and penetrating downwards to the depth of eight feet or more.

THE Department of Botany has been presented with the remainder of W. Barton's herbarium excepting the genus *Rosa*. The present consignment is of about 12,000 sheets with carefully mounted and well-arranged plants, the whole in an excellent condition. The herbarium includes that of H. J. Riddelsdell and Mrs. Foord Kelsey. It is chiefly British, but includes some Alpine collections. The 20,000 sheets make an extremely valuable addition to the collections. Mr. N. Douglas Simpson has presented about 500 flowering plants from the Anglo-Egyptian Sudan. These form a most useful gift as they supplement the collection made by J. E. Dandy, assistant keeper in the Department, on his recent expedition. A collection of 750 flowering plants by H. H. Slater from Iceland, Nova Zembla, Kolguev, has been purchased; it fills some gaps in the Department's extensive series of northern plants. Seven note-books which formerly belonged to Edward Forster (1765–1849) have been purchased from the Saffron Walden Museum. They contain a good deal of information about the plants he collected, and can now be again associated with his herbarium which has been in the Department of Botany since 1849. Robert Brown purchased it at the sale of Forster's books and herbarium, and it formed the nucleus of the British Herbarium.

Cambridge University Botanic Garden

CONSIDERABLE publicity has been given in the Press to the will of the late Mr. R. R. Cory, who was, in his lifetime, a generous benefactor of the Botanic Garden in Cambridge. He bequeathed the residue of his estate to the University for the benefit of the Garden, with the provision that the income from £30,000 of the residue should be used for certain specific purposes. This has led to the impression that the Garden would now be provided with an adequate income. Prof. A. C. Seward, professor of botany in the University of Cambridge, informs us, however, that "because of annuities created by Mr. Cory's will, the University should not expect any income for the Garden from his estate for many years to come. This means that the help hitherto given by the 'Friends of the Botanic Garden', by the promoters of the Somerset Employment Fund and by others interested in the Garden will be as urgently needed and as gratefully received as in the past."

Fireball of January 3, 1935

MR. A. KING, 53 Victoria Road, Ashby, Scunthorpe, Lincs, sends us the following particulars of this object: At 9h. 24½m. in the evening of January 3 a fireball, which was nearly as bright as the full moon, shot across south-west England. There were about sixty observations, ranging in place from Peterborough to 10 miles south of Falmouth. From the best of these the following path was deduced: Began, 55 miles high over English Channel, 23 miles south of Christchurch; mean deviation, 3·0 miles. Ended, 20 miles high over 4m. south east of Wotton-under-Edge, Glos.; mean deviation, 1·8 miles. Length of visible track, 92 miles; speed, 13 miles per sec. Radiant, 76°–15°, altitude, 22·6°. The fireball exhibited remarkable colour changes during its flight, and drew out a red tail. A double detonation was heard at Dursley; at Crewkerne the object was seen to split into two halves towards the end of the path, which would seem to account, on the assumption that each piece set up its own shock-wave, for the Dursley observation. The velocity, allowing for air resistance, was of the parabolic order. Assuming parabolic speed, the application of the correction for zenith attraction brought the radiant-position to 77°–20° and yielded the orbit: ι, 20·5°; π, 139·2°; Ω, 102·6°; q, 0·8865. The theoretical parabolic speed was 14½ miles per second.

Bibliography in Entomology

THE annual meeting of the Royal Entomological Society of London was held on January 16. In his presidential address, Dr. S. A. Neave took as his subject the development of bibliographical work relating to entomology. After dealing briefly with the growth of bibliographical compilations on the subject, Dr. Neave described the organisation responsible for the production of the monthly issues of the *Review of Applied Entomology*. His own very close connexion with the founding and growth of this periodical enabled him to give to his audience an intimate explanation of the manner in which the literature is surveyed and abstracted: the details of editorial duties and the work of preparing the elaborate indexes which are so prominent a feature in each completed volume. This well-known publication enjoys a world-wide circulation, and aims at keeping workers posted, by means of summaries, in the vast literature pertaining to the agricultural, medical and veterinary aspects of entomology.

Vocational Guidance in the United States

THE vocational guidance scheme which has been in operation in Great Britain for twenty-one years was recently reviewed at the request of the Minister of Labour by a committee of the juvenile employment councils. On the other side of the Atlantic also the 'coming of age' of vocational guidance as a function of the State has been recognised, and the very wide implications of the 'new deal' in this regard are discussed by the associate professor of education and sociology in the University of Pittsburgh in an article in *School Life* of September. It is pointed out that, in the past, vocational guidance has to a large extent been stultified by the gross inequalities in occupational rewards—inequalities which it is one of the purposes of the 'new deal' to reduce. Further, it has been a matter of national pride that everyone has the right to aspire as high as he will, regardless not only of social position and antecedents but also of apparent qualifications of intellect and character, and however obvious it may be to a vocational adviser that his aspirations are incommensurate with his abilities. Now for the first time the view is tenable that society will not tolerate the waste involved in maintaining this conception, already largely illusory, of the individual's right to freedom of choice of occupation. A guidance far more positive and compelling than hitherto will obviously enhance the importance of the agencies responsible for it and, moreover, all teachers, supervisors and curriculum-makers will be increasingly preoccupied with their function of exploring and testing their pupils' capabilities.

Burden Mental Research Trust

AT a meeting held recently in London, the committee of administration had before it reports of the first year's working of the Burden Mental Research Trust, which Mrs R G Burden endowed a short time ago with £10,000. The investigations contemplated by the Committee are being carried out by Dr J A Fraser Roberts, assisted by Dr R M Norman and Dr Ruth Griffiths. An extensive survey of the mentally normal as well as the mentally abnormal has been initiated, and when the Trust eventually publishes its final report, it is hoped and expected that much valuable information will be forthcoming as to the nature of the transmission of mental abilities and disabilities. The Trust has also arranged for the co-operation of other distinguished investigators from different parts of Great Britain, one of whom—Dr Shepherd Dawson of Glasgow—has already complied with the request of the Committee.

Vital Statistics for 1934

THE provisional figures of the vital statistics for the year 1934 have been issued by the General Register Office, Somerset House. They are as follows for England and Wales: live births, 14·8, and deaths (crude rate), 11·8 per 1,000 resident population, and infant mortality rate (deaths under 1 year per 1,000 registered live births), 59. The birth rate shows an increase of 0·4 per 1,000 above the low record of 1933, and is noteworthy as being the only increase recorded since 1920, except in 1928, when there was a slight improvement of 0·1 following an exceptional fall in the previous year. The crude death rate is 0·5 below that for 1933, and only 0·4 above the lowest recorded in 1930. The infant mortality rate is 5 per 1,000 below that for 1933, and is the lowest recorded, the previous lowest being 60 for 1930.

Scientific Exhibition at Bombay

THE staff and students of the Royal Institute of Science, Bombay, held a most successful Scientific Exhibition on December 13–18, 1934, in aid of the Bombay hospitals. In a country like India which possesses few scientific museums, such exhibitions have great educational value, and the example of the Bombay Science Institute might well be followed elsewhere. About a thousand pounds were realised for the hospital fund. It may be remembered that similar exhibitions were organised in London several years ago in connexion with the King Edward's Hospital Fund and were very successful.

Solid and Liquid Gases in Science and Industry

THE low temperature exhibition, which is being arranged by the Science Museum, has already been mentioned in these columns; we now learn from the director of the Museum, Col E E B Mackintosh, that the opening date has been postponed until March 1936 in order to give a longer time for the preparation of the exhibits. The exhibition will remain open until the end of May and will therefore immediately precede the Seventh International Congress of Refrigeration to be held in Holland in May 1936. Promises of several interesting exhibits have already been received and the committee, under the chairmanship of Mr H T Tizard, has made considerable progress with the arrangements. The other members of the committee are Dr Ezer Griffiths, Prof P Kapitza, Prof F A Lindemann, Prof J C McLennan, Lord Melchett, Mr C C Paterson, Dr J D Pollock, Prof F Simon, Prof M W Travers and Mr R S Whipple, while the Museum officer responsible for carrying out the arrangements is Mr T C Crawhall, who was also responsible for the Refrigeration Exhibition recently held in the Science Museum.

Standardisation of Hospital Equipment

A COPY of a report made by a Committee set up in 1931 by the Public Health Congress Council, 13 Victoria Street, London, S W 1, to explore possibilities of standardisation of hospital equipment in Great Britain has been forwarded to county and county borough councils by the Ministry of Health (Circular 1410). It is concluded that some 30 per cent of the total maintenance costs of hospitals is incurred in respect of goods that can be readily standardised, without affecting the efficient working of institutions or interfering with the requirements of their professional staffs. It is shown that by standardisation and bulk purchasing, economies of 10–30 per cent may be effected. Standardisation is applicable to hospital furniture and textiles, crockery, cutlery, surgical materials and rubber goods, office requisites and many other articles; examples are given of economies that can be effected in this way, and reports of committees that have considered the subject in Germany and in New York are given in appendixes.

New Map of Hispanic America

IN 1920 the American Geographical Society began the compilation of a map of South America from existing sources. The available material is considerable, but so far no general map had been produced in any sense representative of the existing information. The Society now announces the publication of fifty of the hundred and two sheets which together will cover America from Mexico to Tierra del Fuego. Already large blocks including most of Chile and much of Brazil are ready. The scale is 1 : 1,000,000 and the style is in conformity with the International Map of the World on that scale. The Society also announces the publication of a catalogue of the maps of Hispanic America in four volumes, giving a complete list with critical notes of all the source material used in the compilation of the map

Announcements

It is announced in *The Times* of January 25 that the Loder Cup, awarded for "meritorious service in the cultivation and preservation of New Zealand flora", has been awarded to Lord Bledisloe who, during his term of office as Governor General of New Zealand, has done much for the protection of forests and encouraged the cultivation of the native flora

Lord Hirst of Witton has been elected an honorary member of the Institution of Electrical Engineers The thirteenth award of the Faraday Medal of the Institution has been made to Dr F B Jewett, president of the Bell Telephone Laboratories, New York The Faraday Medal is awarded not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution

"In order to bring to the notice of those interested in the applications of physics to the development of industry, to assist those engaged in industrial research and generally to promote the application of physics to industry" the Institute of Physics is arranging conferences on industrial physics A conference on "Vacuum Devices in Research and Industry" will be held in Manchester on March 28–30, under the presidency of Prof W L Bragg Membership of the conference is open to all interested, and there is no fee At the University there will be an exhibition of instruments, apparatus and books Further information can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Road, London, S W 7

The Faraday Society will hold a general discussion on "The Structure of Metallic Coatings, Films and Surfaces" at the Imperial College of Science and Technology, London, S W 7, on March 29 30 An introductory paper will be read by Dr C H Desch The discussion will be divided into two parts Part 1 will be on "Electron Diffraction Methods" Prof G P Thomson will read a paper on "An Apparatus for Electron Diffraction at High Voltages"; Prof G I Finch is to deal with "Electron Diffraction and Surface Structure", and papers by several foreign visitors will follow The second part of the discussion will be on "The Structure of Metallic Coatings" Prof E N da C Andrade will read a paper on "The Crystallisation of Thin Metal Films", and papers by distinguished workers at home and abroad are promised Further information can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, W.C 1.

The Institute of Chemistry will celebrate its charter jubilee this year. The Institute was founded in 1877, and incorporated by Royal Charter in June 1885 Arrangements are being made for a banquet to be held on July 9 and a reception on the following evening

A David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, will be awarded in July 1935 by the Royal Society of Edinburgh to the person, who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases A similar award will be made every three years

The Dobree collection of European Noctue which has been in the Museum at Hull for many years, and a catalogue of which (Pp. xv + 156 1*s.*) was issued in 1909, contained a certain number of type specimens In the interests of students of entomology, it seemed desirable that these types should be in the national collection, and arrangements have been made whereby they are now in the British Museum (Natural History) at South Kensington, which has supplied suitable specimens to take their places at Hull

Applications are invited for the following appointments, on or before the dates mentioned:—An engineer at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W 1 (Feb 6). A borough electrical engineer for Middlesborough—The Town Clerk, Municipal Buildings, Middlesborough (Feb 11) A physiological chemist at the Imperial Institute of Agricultural Research, Bangalore—The High Commissioner for India, General Department, India House, Aldwych, London, W C 2 (Feb 15) An assistant in the Essex Museum of Natural History—The Principal, West Ham Municipal College, Romford Road, E 15 (Feb 15). Assistant electrical engineers in the Admiralty Service—The Secretary to the Admiralty (C E Branch), Whitehall, London, S.W.1 (Feb. 16) Assistants in clinical pathology, morbid anatomy, bacteriology and pathological chemistry in the British Postgraduate Medical School, Ducane Road, Hammersmith, W 12—The Dean (Feb 18) A lecturer in biology at Whiteland's College, Putney, London, S W 15—The Secretary (Feb. 20). A lecturer in chemistry in the Leicester College of Technology —The Registrar (Feb. 22) A professor of chemistry in University College, Exeter—The Registrar. A lecturer in natural history in the Froebel Educational Institute, Grove House, Roehampton Lane, S W.15—The Principal A Cargill professor of applied physics in the University of Glasgow—The Secretary to the University Court. A Gardiner professor of physiological chemistry in the University of Glasgow—The Secretary of the University Court. An assistant research engineer at the B.B.C.—The Chief Engineer, Broadcasting House, London, W.1. A temporary assistant lecturer in mechanical engineering at the Gloucester Technical College—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 189

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Origin of the Cosmic Rays

FROM the properties of the kinematic world-models which I have been investigating during the past two and a half years, it can be shown that any unimpeded free particle, at large in inter-galactic space, undergoes acceleration as reckoned by an observer located on any arbitrary nebula, and attains the speed of light at some finite epoch in the experience of that observer. It then decelerates It can also be shown that at any arbitrary epoch, in any arbitrary domain of inter-galactic space, there will occur some particles possessing velocities arbitrarily close to that of light. If such a particle, of atomic dimensions, happens to undergo a collision during this phase of its trajectory, it will give rise to effects similar to those observed in cosmic ray experiments I therefore identify the primary agency responsible for cosmic rays with high-speed particles accelerated to the vicinity of the speed of light by the gravitational pull of the rest of the universe[1]. The arguments required are purely kinematical, and involve no appeal to any specific theory of gravitation, or any arbitrary hypotheses

This identification is compatible with the corpuscular character assigned to the primary agency by many authorities The identification accounts for the observed isotropy, and it provides the origin of the high energies, predicting indeed that there is no upper limit to the energy of a single 'ray'. The energy is drawn from the infinite energy associated with the infinitely many particles constituting the universe. Lastly, the identification removes the old impasse to which other theories of the origin of cosmic radiation have appeared to lead. that if the primary rays were born in the interiors of stars, it is difficult to see how they could ever get out, yet if they were born as a result of multiple collisions in inter-galactic space, it is difficult to see how the inter-galactic density of matter could be high enough.

A full account of these investigations will appear shortly in a volume to be published by the Clarendon Press. The results were first described at Dr. N. V. Sidgwick's colloquium at Oxford on February 19, 1934, and have been discussed in numerous lectures elsewhere.

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Jan. 11.

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[1] cf Bothe and Kolhörster, *Z. Phys*, 56, 777, 1929

'Extra' Rings and Bands in Electron Diffraction Patterns

SO-CALLED 'extra' or forbidden rings have been observed from time to time in electron diffraction patterns, and their origin has been attributed to half-order diffractions or impurities. Cases in which more than one such ring have occurred in a single pattern have been rare. We have obtained patterns from platinum, gold, silver, cobalt, nickel, chromium, iron, tin, graphite and zinc oxide exhibiting not only up to as many as 14 'extra' rings, but also remarkable circular bands with well-defined heads

The main facts relating to these rings and bands, so far as they have been ascertained, are as follows: (1) The method of production of the specimen is immaterial, but the crystals must be orientated; (2) specimens of similar thickness and method of preparation show much less background if the crystals are orientated than when randomly disposed, (3) for a given orientation the 'extra' ring and band pattern is characteristic of the crystal lattice, for example, all body-centred cubic polycrystalline films with (111) face orientation yield 'extra' rings in the same relative positions, (4) no 'extra' spots have been observed in single crystal patterns, (5) with a suitable film, the thickness being rather critical, a pattern consisting almost wholly of 'extra' rings can be obtained, finally, (6) one head of each band coincides with a normal ring or with the central spot, while the other consists of an 'extra' ring. Fact (1) excludes impurity as a contributory factor, and (5) suggests that secondary scattering plays no material rôle in the formation of 'extra' rings; indeed, it can be shown that a primarily diffracted ray, *hkl*, on undergoing a second scattering, *h'k'l'* in the same crystal will give diffracted rays falling on normal pattern rings.

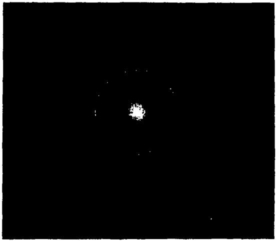

FIG 1

It seems to us that the 'extra' rings and bands owe their origin to the external crystal shape, that is, to the boundary faces through which the electron beam leaves the crystals. For example, the pattern, Fig. 1, was obtained from a face-centred cubic polycrystalline silver film orientated with 110 planes normal to the beam, that is, equivalent to a single crystal rotating about an axis in the beam parallel to a cube-face diagonal. Four distinct 'extra' rings lie within the very intense 111 ring, and two conspicuous bands are visible, one between the central spot and the first 'extra' ring and the other between the 200 and the outermost extra' ring just inside the 111 The first, third and fourth 'extra' rings correspond to diffraction of the primary beam by plane gratings consisting of the atoms in the (111) exit faces, while the second and also the fourth correspond to diffraction by (120) exit planes As the electron wave fronts pass down the inclined exit faces, the third Laue condition and the structure amplitude restrictions relax and finally disappear, with the result that one intense band is swept out between the 200 and the fourth 'extra' ring and another between the central spot and the first 'extra' ring A similar explanation has been found to account for the other bands and 'extra' rings so far observed

The value of the 'extra' rings and bands in crystal structure analysis is evident We have here for the first time a possible means for identifying the actual crystal faces in crystals of sub-microscopic dimensions

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Differences between Male Hormone Extracts from Urine and from Testes

THE identity of the male hormone, extracted respectively from urine and from testes, has been assumed but never proved since the original isolation of active substances from these two sources. We[1] and also other authors[2,3] have pointed out various chemical and biological differences. The following experiment shows a more definitive differentiation.

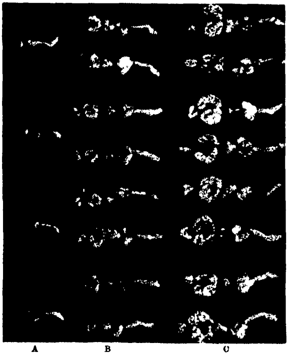

FIG 1 Prostate, seminal vesicles, periurethral tissue and penes of rats. A, controls, B, treated with urinary extract; C, treated with testis extract.

Twenty-one male rats were castrated when 3–3½ weeks old, and at the age of 6–6½ months, when the average weight was about 260 gm., were divided into three groups The first group of five animals was untreated The second group of eight animals received injections of male hormone extracted from urine, the third group of eight animals, injections of male hormone extracted from testicles

The extracts were administered during four periods of six days, the dosage being increased at each phase The preparations had been standardised on capons During the first six days, 2 × 0 5 comb units (C U) daily were given, during the second six days, 2 × 1 C U, during the third six days 2 × 2 C U, and during the fourth six days 2 × 4 C U When the animals were killed on the day after the last injection, they showed extraordinary differences in the size of the seminal vesicles (Fig 1) The average weight of the seminal vesicles was 8 mgm in the controls, 113 mgm in the group treated with urinary extract and 538 mgm in the group treated with testicular extract The difference in size of the prostate of the injected animals was much less (6 mgm, 66 mgm, 105 mgm) The histological findings are to be published later

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Dec. 24

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[1] Laqueur, C S, and Münch, *Ber ges Physiol*, 61, 3/4, 1931

[2] Gallagher, T F, and Koch, F C, *Endocrinology*, 18, No 1, 107, 1934

[3] Matsuzaki, K, *Jap J Med Sci*, 7, No 1, 1934

[4] Freud, J, and Laqueur, E, *Acta Brevia Neerl*, 4, 100, 1934

[5] Freud, J, *Acta Brevia Neerl*, 4, 81, 1934.

Excretion of Nitrogenous Compounds from the Root Nodules of Leguminous Plants

THE activities of the nodule, and particularly the excretion of nitrogenous compounds from the nodule into the medium, are largely dependent upon the supply of air to the roots The quantity of excreted nitrogenous compounds is the greater the larger the culture flask. This fact has been clearly demonstrated by our experiments with sterile cultures of inoculated peas in quartz sand The results also showed that the rate of excretion is proportionally highest at an early stage of development of the plants when the nodules are still quite young Hence it can be concluded that the passage of the nitrogen compounds into the sand actually is due to excretion and not to a decomposition of the nodule proteins.

We have previously shown[1] that nitrogen compounds, found in sand after growth of inoculated leguminous plants under sterile conditions, consist mainly of amino-acids. Since these compounds cannot be breakdown products of nodule proteins it is reasonable to assume that the fixation of nitrogen takes place at the surface of the bacterial cells in the nodule, and that nitrogen compounds thus formed are partly utilised by the host plant and partly diffused into the soil. This view receives additional support from the fact that the proteoclastic action of leguminous bacteria and nodules is very slight.

Excretion of nitrogenous compounds from root nodules is not attributable to a mechanical wounding of the root hairs through sharp-edged sand particles, since the same phenomenon was found to take place also in agar cultures if the access of air to the nodules and roots is facilitated by allowing the agar to shrink. Consequently, the excretion is a natural process which is closely dependent on the air-content of the medium

Recently we have found[2] that pea and clover nodule bacteria effect a butyric fermentation of glucose, whereby hydrogen is also produced. This finding will probably help us to gain a clearer conception of the mechanism of nitrogen fixation. All attempts to effect a fixation of nitrogen by free living nodule bacteria have so far led to negative results This is probably due to the fact that ordinary sugar compounds are very poorly utilised by these bacteria. It seems, therefore, natural to assume that the nodule bacteria receive from their host plant some particularly suitable sugar compound which is readily utilised, and provides the energy required for nitrogen fixation Theoretically it would thus be possible to effect a fixation of nitrogen by free-living nodule bacteria as soon as the chemical nature of the specific carbohydrate is ascertained.

Further details will be published in the *Journal of Agricultural Science*

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[1] Virtanen, A I, v Hausen, S, and Karström, H, *Biochem Z*, 258, 106, 1933 NATURE, 131, 534, April 15, 1933

[2] Virtanen, A I, Norlund, M, and Hollo, E, *Biochem J*, 28, 796, 1934

Synthetic Compound with Vitamin B_2 Activity

ACCORDING to a note[1] in NATURE on a lecture recently given by me, synthetic 6.7-dimethyl-9-1-araboflavin, $C_{17}H_{20}N_4O_6$, possesses similar growth-promoting activity to that of lactoflavine (vitamin B_2). The statement, that a catalytically active compound results by combination with the colloidal carrier of the 'yellow enzyme' of O Warburg and W. Christian is incorrect, both for the natural and synthetic pigment, in so far as experiments *in vitro* are concerned. According to the *in vitro* experiments described by H. Theorell[2], phosphoric acid plays an important rôle in the combination. *In vivo*, on the other hand, a combination of both pigments with phosphoric acid and protein to form yellow enzymes apparently takes place *In this sense only*[3] does the synthesis of a compound with vitamin B_2 activity represent also the first synthesis of the active group of an enzyme.

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Jan. 9.

[1] NATURE, 134, 966, 1934

[2] *Biochem. Z*, 275, 37, 344, 1934

[3] For the original German text, see *Ber*, 67, 2084, 1934 68, 166, 1935

Formulæ and Equations in Nuclear Chemistry

THE question which Prof. Lowry raises on p. 36 of NATURE of January 5 is one which has perforce exercised my mind in the last few days, since I am at present revising the final page-proofs of the report of the International Conference on Physics. He refers to the different positions in which the numerals indicating the mass and atomic number of a nucleus are placed by different writers. Thus, we have $^{4}_{2}\mathrm{He}$, $_{2}\mathrm{He}^{4}$ and $\mathrm{He}_{2}{}^{4}$ He points out that if the last form is used, there is a difficulty in showing the number of atoms in a molecule in the customary English fashion (for example, Cl_2) whilst both the second and third forms introduce a difficulty for the French chemist, who is in the habit of writing Cl^2 for a molecule of chlorine

As a matter of fact, the ideal symbolism would leave space not only for this numerical indication, but also for a sign to denote the state of ionisation. The two requirements together completely rule out both the second and third forms above, leaving only the first as suitable for general adoption

From a logical point of view, if the symbol refers to a nucleus and not to a complete atom, the lower numeral is unnecessary. If a nucleus has subscript 2, it is helium, and conversely. Thus, the simplest method would be to write $^{4}\mathrm{He}$, $^{6}\mathrm{Li}$ or $^{7}\mathrm{Li}$ The only objection is the ugliness of the juxtaposed large and small figures in such an equation as $2{}^{1}H_2 + {}^{16}O_2 = 2{}^{1}H_2{}^{16}O$.

If we were bold enough, we should adopt a logical scheme, and save the printer much trouble, by giving up the letter instead of the subscript An atom would be represented by a number or numbers in a bracket: (1, 1) and (1, 2) for ordinary and heavy hydrogen, (2, 4) for helium, (3) to mean either isotope of lithium, and so on.

The above reaction would then be written

$$2\,(1,\ 1)_2 + (8,\ 16)_2 = 2\,[(1,\ 1)_2(8,\ 16)]$$

It is easy with this notation to show states of ionisation. $(17, 35)^- + (19, 39)^+ = [(19, 39)\,(17, 35)]$ or $(17)^- + (19)^+ = [(19)\,(17)]$ would replace the familiar $Cl^- + K^+ = KCl$

If it is decided to retain the use of letters, I would plead for the use of H to signify all the isotopes of hydrogen. When H is restricted to mean $^{1}_{1}\mathrm{H}$, we have the additional symbols $^{2}\mathrm{D}$ and $^{3}\mathrm{T}$ (with perhaps $^{4}\mathrm{Q}$ to follow) to remember, and there is no symbol available to mean hydrogen in general. One is certainly needed for this purpose, and the need is illustrated on p 23 of the issue of NATURE to which I have already referred.

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Absorption Spectrum of Sulphur Monoxide

IN a recent investigation[1], we attempted to detect sulphur monoxide in the photochemical decomposition of sulphur dioxide by examining the absorption spectrum of the latter before and after its irradiation. An absorption spectrum of the monoxide was reported to have been found by P. W. Schenk and H. Cordes[2] in the spectral region between 3300 A. and 2500 A., and although sulphur dioxide has very strong absorption bands in this region, they found evidence of the spectrum of sulphur monoxide, even when its concentration was 10^4 times smaller than that of the dioxide[3]. This spectrum, however, could not be detected in the photochemical decomposition of sulphur dioxide, and it has been assumed[1] that the act of photo-dissociation provides sulphur monoxide with a surplus amount of energy which makes it react instantaneously. But since this surplus amount of energy is only 13 cal. for 1950 A., this conclusion did not seem quite satisfactory. It seemed advisable, therefore, to ascertain whether the absorption spectrum described by Cordes and Schenk was to be attributed to the presence of the monoxide.

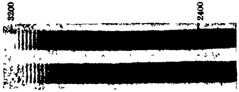

FIG 1 Absorption spectrum of sulphur dioxide, (*a*) before, and (*b*) after discharge.

An electrodeless discharge was produced in sulphur dioxide and the absorption spectrum was taken before and immediately after the discharge, as shown in Fig 1 The intensity of the spectra is not quite the same, for a thin sulphur film had partly covered the plate during the 2½ hours of discharge, and it seemed necessary to take a longer exposure. Nevertheless, in spite of the difference in intensity, the identity of the two spectra cannot be doubted, so that there is definitely no new absorption spectrum produced by the discharge That is quite clear in the original plate, but naturally not so clear in the reproductions. The presence of sulphur monoxide, on the other hand, in the discharge is proved by its emission spectrum, taken during the discharge (Fig 2), which shows the same bands as tho spectrum that was analysed first by V Henri[4] and later by E V. Martin[5]

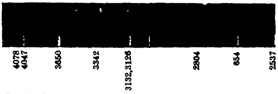

FIG. 2. Emission spectrum of sulphur monoxide, with mercury lines below.

It seems necessary, therefore, to ascribe the absorption spectrum found by Cordes and Schenk to some product of the discharge other than sulphur monoxide, in other words, our experiment indicates that sulphur monoxide in small concentrations has no absorption spectrum between 3100 and 2500 A.

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[1] G Kornfeld and M. McCaig, *Trans Farad Soc*, **30**, 991; 1934.
[2] H Cordes and P W Schenk, *Z anorg u allgem Chem*, **214**, 33; 1933 *Z. Elektrochem*, **39**, 594, 1933 *Trans Farad Soc*, **30**, 31, 1934
[3] P. W. Schenk and H Platz, *Z anorg u allgem Chem*, **215**, 113, 1933
[4] V Henri and F. Wolff, *J Phys et Le Radium*, VI, **10**, 81, 1929.
[5] E V Martin, *Phys Rev*, **41**, 167, 1932.

Sources of Error in Absorption Spectroscopy

IN studying the absorption spectra of the vapours of the homologous aldehydes[1] a band spectrum was observed in butyric and *iso*-butyric aldehydes, which was ultimately discovered to be due to benzene. Inquiries showed that the catalyst used in the preparation of the aldehydes had been washed with benzene, thus accounting for the presence of an aromatic impurity which would not normally be expected to occur in aliphatic compounds. The spectrum is, however, so intense that, when the observation tube had been used to secure a comparison spectrum of benzene, it was very difficult to get rid of this spectrum in subsequent exposures

In attempting to photograph the fine structure of acetone, Dr. F C Garrow in 1931 observed a very fine series of bands, corresponding in general character with those recorded by Bowen and Thompson[2], which Norrish, Crone and Saltmarsh[3] and Noyes, Duncan and Manning[4] have not been able to reproduce. The bands observed by Dr Garrow were, however, due to interference, since they were only slightly weakened when the tube was empty, they were also observed with a single end plate, and were only got rid of by using other quartz plates Bands of a similar character have been described by Schaeffer and others[5], and those now recorded are probably similar in origin The occurrence of a few weak bands at wave-lengths less than 2900 A has already been recorded by us[1], but no trace of a genuine fine structure could be found in this region

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Dec 15

[1] Snow and Eastwood, NATURE, **133**, 908, June 16, 1934
[2] Bowen and Thompson, NATURE, **133**, 571, April 14, 1934
[3] Norrish, Crone and Saltmarsh, *J Chem Soc*, 1458, 1934
[4] Noyes, Jr, Duncan and Manning, *J Chem Phys*, **2**, 717, 1934
[5] Selényi, *Math u naturw Berichte aus Ungarn*, **27**, 76, 1909 Chinmayanandam, *Proc Roy Soc*, A, **95**, 176, 1919 Ghosh, *Proc Indian Soc for Cultivation of Science*, **7**, 53, 1922 Schaeffer and Fricke, *Z Phys*, **14**, 253, 1923 Schaeffer, *Z Phys*, **17**, 155, 1923

Properties of Liquid Films in Fine-Pored Systems

THE properties of liquids, and in particular of water, when held by finely porous material, are of interest to workers in both the pure and applied fields A growing mass of evidence points to the necessity of assuming a modification in properties of such liquid films even in thicknesses corresponding with many molecular layers.

Shereshefsky[1] and others have produced definite evidence that measured vapour pressures of liquids in small capillaries (of radius 0 0005 cm. and less) are very much smaller than those calculated from the Kelvin equation. In view of this result, it is interesting to note that experiments at the Building Research Station, shortly to be published, have shown that for several finely pored plastic materials, the hydrostatic suction necessary to remove water is of quite a different order from that which would be expected from the vapour pressure relation. Similar anomalous behaviour has been found when the same moist plastic materials are brought to equilibrium with a solution of sugar of known osmotic pressure through a semi-permeable membrane. Calculations show that large discrepancies also exist in published literature, where it is possible to compare sets of determinations by two dissimilar methods. Thus Szigeti's[2] measurements of vapour pressures and negative absorptions from sugar solutions show these anomalies.

Among other cases of anomalous behaviour reported which may be due to the same causes the following may be noted: Glixelli and Wiertelak[3] found low values for the electro-kinetic potential in silica gels which became normal in ignited gels White, Urban and Van Atta[4] found very low values for stream potentials in pyrex glass capillaries of less than 0·001 cm diameter. Wolkowa, in measuring the velocity of penetration of liquids into finely powdered materials, found regular behaviour with non-polar liquids but anomalous results with water and other polar liquids Measurements carried out at the Building Research Station of the dielectric constant of liquids in porous materials and its variation with frequency have been found to exhibit discrepancies which may prove to be related with observations on water in soils made by Smith-Rose[6]

It is suggested that Hardy's[7] conception of molecular orientation in thin liquid films formed on the surface, for which strong evidence is afforded by their behaviour as lubricants, may provide a means of reconciling the anomalies to which we now direct attention In such films, the work required to tear up 'by the roots' orientated chains of molecules, as is necessary in molecular exchanges between film and gaseous phase or across a semi-permeable membrane, may be much greater than that required to slide layers from the surface in a manner which may be considered to occur when a direct hydrostatic suction is applied This crude picture is, of course, open to objections which it is not possible to discuss here, but it may serve to emphasise the desirability of carrying out measurements by two or more different methods in any studies designed to further our knowledge of the capillary properties of liquids in finely porous systems

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Dec 1.

[1] Shereshefsky, J L, "Vapour Pressure in Small Capillaries", *J Amer Chem Soc*, **50**, 2966, 1928

[2] Szigeti, P, "Über sog negative Adsorption und Dampfdruckisothermen an Permutiten und Tonen", *Koll Beih*, **38**, 99, 1933

[3] Glixelli, S, and Wiertelak, J, "Das Elektrokinetische Potential des Kieselsaure Gels", *Koll Z*, **42**, 85, 1927

[4] White, H L, Urban, F, and Van Atta, E A, "Correlation of Stream Potentials and Surface Conductance", *J. Phys Chem*, **36**, 3152, 1932

[5] Wolkowa, Z W, "Porositätsbestimmungen von Dispersoiden nach der Eindringsgeschwindigkeit von Flüssigkeiten", *Koll. Z*, **67**, 280, 1934

[6] Smith-Rose, R L, "Electrical Properties of Soil", *Proc Roy Soc*, A, **140**, 359, 1933

[7] Hardy, Sir W B, "Problems of the Boundary State", *Phil. Trans*, A, **230**, 1, 1932.

Galvanometer Relays

THE use of the rectifier photo-cell to amplify galvanometer deflections is now well known; but I have never seen any explicit mention of the fact that, with the customary set-up[1], the deflections of the second galvanometer are not in general proportional to those of the first. The discrepancy arises because the area of the photo-cell illuminated changes as the deflection of the primary galvanometer changes

I am now using a modified system in which this defect is absent. The beam of light from the primary galvanometer mirror forms a rectangular image on a lens, immediately behind which is a pair of right-angled prisms, which throw part of the light on to one cell and part on to another. The lens forms an image of the galvanometer mirror on each cell. As the rectangular image moves across the lens more light is thrown on to one cell and less on to the other: but there is no change of the cell area illuminated in either case, the only effect being to vary the brightness of the images on the cell surfaces Thus, non-uniformity of the sensitivity of the surfaces cannot affect the proportionality between the deflection of the two galvanometers.

The two cells are connected across the galvanometer in parallel with, and in opposition to, each other; this method of connexion gives considerably greater amplification than can be obtained with a divided cell of the same photo electric sensitivity.

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[1] A V Hill, *J Sci Instr*, **8**, 262, 1931 NATURE, **133**, 685, 1934 R V Jones, NATURE, **133**, 872, 1934 *J Sci Instr*, **11**, 302, 1934

Addition of Hydrogen Bromide to Olefines

THE results of several investigations have confirmed the discovery[1] that oxygen and peroxides ('oxidants') may greatly affect the addition of hydrogen bromide to olefinic substances[2] In all these investigations the double-bond has been in the terminal position ($CH_2 = CH - CH_2 -$), oxidants causing the addition of hydrogen bromide to yield $CH_2Br - CH_2 - CH_2 -$, and 'anti-oxidants' allowing the formation of $CH_3 - CHBr - CH_2 -$.

In order to ascertain whether the same effect could be produced in the reactions of an olefine containing a non-terminal double-bond, we have studied additions to *iso* undecylenic acid[3] ($CH_3 - CH = CH - (CH_2)_7 - COOH$) This olefine adds hydrogen bromide relatively slowly, and yields the same proportions of 9- and 10-bromoundecoic acids, whether oxidants or anti-oxidants are present As undecylenic acid ($CH_2 = CH - (CH_2)_8 - COOH$) clearly shows the peroxide effect (Ashton and Smith, loc. cit) there is now some evidence that only terminal double-bonds are susceptible

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Dec 18

[1] Kharasch and Mayo, *J Amer Chem Soc*, **55**, 2468, 1933

[2] Kharasch and co-workers, *ibid*, **55**, 2521, 2531, 1933 **56**, 244, 712, 1212, 1243, 1642, 1782, 1934 Smith, NATURE, **132**, 447, 1933 Linstead and Rydon, *ibid*, **132**, 643, 1933 Ashton and Smith, *J Chem. Soc*, 435, 1308, 1934 Brouwer and Wibaut, *Rec trav chim*, **53**, 1001, 1934

[3] Krafft and Seldis, *Berichte*, **33**, 3571, 1900

Ionisation of the Kennelly-Heaviside Layer

THE eclipse observations of August 31, 1932, and Appleton's Tromsø observations, indicate fairly certainly that the normal daytime ionisation in the *E* layer (100 km. height) is due mainly to solar wave radiation, and not to neutral corpuscles as Chapman suggested. But the ionising wave radiation may not be ultra-violet light (in amount corresponding to Planck's formula at the sun's temperature) as now generally supposed. As Eckersley has remarked, if the ionising agent is wave radiation, it must be so penetrating as to be of Röntgen type; but he disbelieves in the emission by the sun of an adequate amount of such radiation (Elias, however, for a time considered such rays to be the cause of the *E*-layer).

But solar conditions seem not to preclude such radiation. If, as Swann has suggested, very fast electrons are produced in sunspots, most of them must lose their energy again in the photosphere and chromosphere, and in so doing will excite Röntgen radiation, both continuous, scattered and characteristic. The emission need not be confined to sunspots. Bartels' *M*-regions show that important solar phenomena can still remain undetected by us.

The mass-absorption coefficient (μ/ρ) of ultra-violet light is too great for this to penetrate to 100 km height. Too little is yet known about the value of μ/ρ for light between the ultra-violet and the Röntgen region; systematic measures using the Hopfield continuous spectrum of helium are very desirable. For ultra-soft Röntgen radiation, the course of the μ/ρ curve is known approximately to $\lambda = 68$ A., for which wave-length Messner recently found $\mu/\rho \simeq 1\cdot46 \times 10^4$. At 700 A., μ/ρ is certainly much greater, probably similar to that of celluloids, for which O'Bryan found a maximum for μ/ρ ($5\cdot8 \times 10^5$) at 800 A. Probably Hulburt's estimate ($\mu/\rho \geqslant 8\cdot8 \times 10^5$) of μ/ρ for ultra-violet ionising light is truer than that used by Försterling ($1\cdot2 \times 10^5$).

The height of maximum ionisation depends essentially on μ/ρ. If $\mu/\rho = 5\cdot5 \times 10^6$ (ultra-violet light), the height at midday must exceed 130 km. if the air temperature T is 218° K., and a lower value of T has not been proposed. This assumes no diffusive separation of the separate gases; if this occurs, the height might be 4 km. lower. It would exceed 200 km. if the outer layers consist of atomic oxygen as suggested by Chapman. Again, the fact that the gases of the atmosphere have absorption *bands* in the ultra-violet implies that the thickness of the absorbing layer must much exceed that of the ionised layer (scarcely 30 km.). Hence ultra-violet light is unlikely to be the ionising agent for the *E* layer, unless its value of μ/ρ has been over-estimated a hundredfold.

We are thus led to conclude that the agent is Röntgen radiation. According as T is taken to be from 218° to 323° K. (and it cannot exceed 100° C. in the *E*-layer), the Röntgen wave-length will lie between 13 A. and 3·5 A., and also, on account of the *K* absorption limit of nitrogen at 31·1 A., from 40 A. to 31·1 A. As regards the characteristic radiations that may be involved, we may note the *K*-radiations from Na (11) to Ca (20), the *L*-radiations of Ca and those from Cu (29) to Sn (50), and the *M*-radiation from Ce (58) to U (92). The soft series for the elements near iron can be of importance only if $T < 218°$ K.

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Eocene Beds of the Punjab Salt Range

MR. E. S. PINFOLD and I have recently made a special examination, on behalf of the Attock Oil Company, of the Eocene beds of the Punjab Salt Range, with the view of determining their exact age. It will be remembered that opinions as to this have varied greatly in the past, some geologists referring them to the Laki, others to the Khirthar, while others again have shelved the question of their precise age by calling them "Hill" limestones or "Nummulitic beds", etc.

I have now found, on examining fossils collected from these Eocene beds by Mr. Pinfold, that the beds are actually divisible into two distinct portions, the lower one belonging to the Ranikot and the upper to the Laki. Having lately received permission from the Attock Oil Company to publish our results, Mr. Pinfold and I hope shortly to produce a paper in which the relevant field and palæontological evidence will be discussed in detail.

L. M. DAVIES.

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"The Horizons of Thought"

I KNOW that a reviewer's comments on a book, especially when published in an international journal, travel many leagues while an author's reply is getting into an envelope, but for all that I would ask you to allow me to comment on your reviewer's words (in NATURE of October 20, 1934, p. 617) concerning my book, "The Horizons of Thought". I am surprised to read that there is a "peculiar method" employed in the book; the reviewer seems to imply that it is a superficial eclecticism, which of course no one could countenance. As a matter of fact, the quotations are used for illustration and application of principles previously worked out and published in preliminary form elsewhere, as indicated in the preface. The reviewer seems to complain because contexts are not stated; they are omitted for the sake of brevity, and also because I was interested not so much in contexts as in contacts and conflicts with the principles worked out. I was interested not so much in elaborating my perhaps "general and obvious", and perhaps even "more or less relevant" conclusions, as in showing how often in contemporary thought their principles are disregarded, with consequences all the way "from mathematics to ethics". Finally, I must disclaim the wish which the reviewer imputes to me, of solving problems which lie beyond the horizons. I think the primary task of philosophy is to work within the island-universe of the sciences (logical, mathematical, natural and social), and treat a great mass of traditional outlying questions non-committally.

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Dec. 5.

I AM interested in Prof. Conger's letter, and I understand his points clearly. To deal with them satisfactorily would, however, occupy more space than could reasonably be asked for in NATURE; and I do not think a controversy on these subjects would serve any practical purpose.

THE REVIEWER.

Symbols for Chromosome Numbers

I AGREE with Miss Schafer[1] that the use of a Greek letter for the basic chromosome number has serious disadvantages and should therefore be dropped. But I think a new symbol is necessary, to avoid the confusion which results from a resuscitation of x for this purpose. This symbol tends to be overworked, presumably because every schoolboy begins his algebra with x as the unknown quantity. In the result we have papers written on the effect of X-rays on the X-chromosome. In this case, however, no confusion results, because the two uses of X are so different.

Formerly x and $2x$ were in universal use for the haploid and diploid chromosome numbers. Since then, usage has gradually shifted to n and $2n$, presumably to avoid confusion with X, which began, after 1900, to be used for the sex chromosome, but x and $2x$ are still employed to some extent in the original sense, as previously pointed out[2], so three uses of the symbol in relation to chromosomes have to be distinguished.

In these circumstances, and in view of the place x has already had in the nomenclature of chromosomes, confusion can only be avoided by adopting a new symbol for the new conception, and I suggest b as a suitable symbol for the basic number

Since this was written, I find that b as a symbol for the basic chromosome number has already been proposed by Sinotô[3]

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[1] NATURE, 135, 109, Jan 19, 1935

[2] NATURE, 134, 1011, Dec 29, 1934

[3] "Chromosome Studies in some diœcious Plants, with special Reference to the Allosomes" *Cytologia*, 1, 112, 1929

Miss Mirsky's "Northern Conquest"

IN my review of this delightful book I was wrong in making it appear on p 884 of NATURE for December 8 that the work was done under the critical supervision of Dr Stefansson I now know that this was not the case The great explorer did not see the book until it was submitted to him in a complete form by the publisher Miss Mirsky is thus entitled to all the credit for her brilliant work

In mitigation of my blunder, I can only say that, like the writer of the legendary article on Chinese metaphysics, I must have combined the information derived from two unrelated statements Those were the phrases in Miss Mirsky's prefatory note (1) "During the three and a half years I spent on the book " and (2) " the generosity with which Vilhjalmur Stefansson placed his fine library at my disposal" Of course, I should not have inferred that the book was written in that library, the use of which only contributed to the compilation of the illustrative maps

HUGH ROBERT MILL

Points from Foregoing Letters

COSMIC rays are identified as particles accelerated to a speed near to that of light by the gravitational pull of the rest of the universe in the kinematic world model put forward by Prof. E. A Milne There is no upper limit to the energy that such a particle may acquire, since it is drawn from that of the whole universe

According to Dr G I Finch and Mr A G Quarrell, the 'extra' rings observed in certain X-ray diffraction patterns are due to the shape of the minute crystals that compose the materials investigated, and may therefore help in finding the shape of sub-microscopic crystals The ordinary X-ray diffraction rings are due, of course, to the lattice arrangement of atoms within the crystals

Male hormone extracts, obtained from testes and from urine, while possessing the same power of stimulating growth of combs on capons, are found by Messrs. E Dingemanse, J. Freud and E Lacqueur to differ in their effect upon the growth of seminal vesicles in castrated male rats. This shows that the urinary and testicular extracts used are not identical.

Prof. A I. Virtanen and Mr. S. v. Hausen point out that the nitrogen compounds (amino-acids) found in soil where leguminous plants are grown are excreted by the bacteria nodules of their roots and are not attributable to mechanical wounding of the roots, because it can be shown that excretion takes place also on an agar culture, provided access of air to nodules is facilitated. The authors have further discovered that pea and clover nodules containing bacteria can produce butyric fermentation of glucose, and they suggest that the bacteria are supplied by the plant with a suitable sugar, which provides energy for the nitrogen fixation More knowledge of this mechanism may lead to the discovery of the conditions necessary in order that the bacteria may fix the nitrogen of the air *in vitro*.

Dr. G. Kornfeld and M. McCaig find that small amounts of sulphur monoxide present in sulphur dioxide after an electrodeless discharge, can be detected by means of the emission spectrum, but not by means of the absorption spectrum, because the dioxide itself has strong absorption bands similar to those of the monoxide

Dr C P Snow and Mr E. Eastwood point out, as possible sources of error in determining the absorption spectrum of vapours, the possible presence of small amounts of impurities and the effect of interference bands due to the quartz plates of the apparatus.

Thin films of liquid such as may exist in finely porous materials have properties different from those of liquids in bulk Messrs B H Wilsdon, D. G R Bonnell and M E Nottage mention their lower vapour pressure, with which is related the greater hydrostatic suction needed to remove water from certain building materials Their osmotic pressure and electrical properties are also abnormal The authors point out that the behaviour of thin films may be connected with the fact that their molecules form more or less orientated chains.

Mr. D H Follett directs attention to the fact that at present, when a photo-cell is used to amplify galvanometer deflections, the amplified deflections are not proportional to the original. He describes an improved instrument avoiding this difficulty.

Neutrons and ultra-violet radiation have been suggested as possible agents responsible for the ionisation present in the electrically-conducting layers of the upper atmosphere which reflect radio waves Eclipse observations have ruled out the neutrons as active agents, while the ultra-violet radiation, from calculations by Dr E A. W. Muller, cannot penetrate in sufficient amounts as far as the E-layer (100 km. high). To account for that effect Müller assumes that the sun emits, in addition, a more penetrating radiation of the X-ray type.

The search for oil has supplied valuable information to geological science in the past. Lieut.-Col. L. M. Davies announces that an examination of the fossils from the early tertiary (Eocene) beds of the Punjab Salt Range in the sub-Himalayan zone shows that these strata belong to two distinct formations (Ranikot and Upper Laki).

Research Items

Discoveries at Troy. The long-awaited discovery of a cemetery at Troy is announced by Dr Carl Blegen, of the University of Cincinnati, in a communication issued by Science Service, Washington, D C This find was made by the third expedition of the University to Hissarlik. A second discovery of importance was on a site about three and a half miles from the actual citadel, at a marginal point of the area Here Dr. Blegen found four graves, apparently of neolithic age, containing skeletons which in his opinion belong to a period antecedent to any settlement hitherto found on the site and representing the earliest inhabitants. At the same point, but at a higher level, were later remains, dating from the time of the fourth and fifth layers of the citadel. The cemetery belonging to Troy itself was found just outside the citadel It is contemporary with the sixth city and consists of a series of urn burials containing ashes, remnants of burnt bones and traces of ornaments which had not been entirely consumed by the funerary pyres The practice of cremation burial, naturally and unfortunately, has destroyed all evidence of the physical characters of the inhabitants of the city. A further discovery among the ruined houses was that of a well-preserved buried floor, which affords the first opportunity here for the investigation of a habitation site The stone bases of columns which supported the upper story are still in place, but determining the alignment of the columns and the recovery of any household goods which the floor may have preserved will be the work of the expedition's next season

Glazed Stones in Antiquity. The first of a series of notes on glazed stones, dealing with glazed steatite, is contributed by Mr Horace C Beck to *Ancient Egypt and the East* (pt 2; 1934) The surface of steatite is found to have been altered by chemical processes due to at least three different methods of treatment The first was to apply a vitreous glaze to the surface and then fire it. This is true glazed steatite, and even when the whole layer of glaze is flaked away, a very hard surface is left on the steatite. A second method was to apply an alkali and fire it, or to apply a glaze of such a nature that when it is flaked away, it leaves a very soft surface on the steatite The third, perhaps a modification of the second, was to whiten the surface, probably with an alkali only and, after heating, to paint on a pattern. The effects of the various processes on the stone are different. All the Egyptian specimens of glazed steatite belong to the first class, and it is almost entirely an Egyptian product. It has been found extending in time from the Badarian period, being earlier than glazed faience, which does not appear until pre-dynastic times, down to the twenty-seventh dynasty The process was used extensively for beads, amulets and scarabs; but after the twelfth dynasty the beads are rare. There are a few very fine specimens of glazed steatite of considerable size, belonging for the most part to the period from the twelfth to the eighteenth dynasty. The beads with the best glaze are the Badarian. The seals from Mohenjo-daro and Harappa, some early seals of a similar nature from Kish and Ur and the great majority of the beads from Harappa belong to the second type, while the third type comprises only a comparatively small number of important beads from Harappa. An examination of six seals and several hundred beads from Mohenjo-daro and Harappa indicates that a different method was employed there from that used in Egypt, and it seems probable that more than one method was practised in the Indus valley

Phenological Observations in Great Britain. The "Phenological Report, 1933" (*Quart J. Met Soc*, 60, No. 255, 1934) deals as usual with facts relating to birds, insects and plants, such as the earliest date of arrival of a migrating species of bird, the earliest date of appearance of a particular insect or plant, supplied by voluntary observers distributed at more than five hundred places throughout the British Isles. The events recorded number more than sixteen thousand. This unwieldy mass of statistics is condensed and to some extent summarised with the aid of various tables and maps, and comparison between these and similar tables and maps in the reports for previous years will enable anyone interested in the natural history of the countryside to study the peculiarities of its seasonal course in this particular year. There is a sufficiently full meteorological summary to allow the influence of the weather in these matters to be gauged, and the year was remarkable enough for its deficient rainfall, its warmth and abundant sunshine to make it a good one for the pursuit of such studies. These reports must be of the greatest possible value for many branches of study, such, for example, as that of bird migration Average arrival dates for twenty species of bird for this year and for the seventeen years 1914–30 are shown side by side by means of lines of equal arrival date (isophenes) The extraordinary warmth of March and April 1933 in those regions from the south-west of Ireland across to Sussex and Kent where this date falls on average rather late in April, did not produce any notable departure from the normal, and in general normality appears to have been the rule. Autumn migrations, both incoming and outgoing, appear to have been decidedly early; no reason for this is suggested in the report It is interesting to learn that a phenological record has been maintained by one family at Hevingham (Norfolk) since 1736, with only one long break (1811–35). This establishes the average dates of arrival of the swallow, cuckoo and nightingale there as April 19, 25 and 26 respectively

Echiuridæ, Sipunculidæ and Priapulidæ of Scottish and Adjacent Waters. Dr. A. C. Stephen has investigated the distribution of the species of these groups in the Scottish area by examining collections made by the Fishery Board for Scotland in the North Sea and adjacent waters. The greater part of the material was taken with the small Petersen bottom sampler, and has come from all over the North Sea, from coastal waters to the edge of the continental shelf (*Proc. Roy. Phys. Soc*, 22, Part 4; 1934). *Priapulus*, *Sipunculus*, *Phascolosoma* and *Echiurus* are of economic importance for they serve as food for several food fishes such as plaice, lemon sole, common dab, witch, gurnard, whiting and haddock. Of these, *Priapulus caudatus* is by far the most frequently consumed, especially by haddocks caught in the

Firth of Forth and St. Andrews Bay; also in fish from the east coast of Scotland, Moray Firth and from over the North Sea. As many as ten specimens have been taken from a single plaice in the Cumbrae district, where it is generally distributed on muddy ground. In the North Sea more than 1,200 stations have been examined with the Petersen grab, and many hauls with other apparatus have been made. *Phascolion strombi* is the only species captured with regularity: the other species have been found at few stations and in small numbers, the reason apparently being, not that they are scarce, but that they burrow beyond the reach of the collecting gear. Little is known about the breeding periods or larval histories of these animals, but a few notes on the subject are given

Earthworm Migrations. In his fourth paper on the earthworms of Burma, G. E. Gates (*Records Indian Mus.*, **35**, Pt. 4, Dec. 1933) emphasises the need for the study of the extent of variation of the characters by means of which species are diagnosed and defined He states that the lack of this information has resulted in the erection of unnecessary varieties and species, and that it is often difficult, if not impossible, to determine whether a particular individual or series of *Drawida* and *Eutyphœus* belongs to an old or a new species, and therefore it is imperative that the types of all old species be re-examined In an interesting reference to migrations of earthworms, the author records an observation that "in the early morning on certain days in October and November at the beginning of the cold season the road is almost covered with worms, one can see worms tumbling down from the banks above on to the road. In the evenings not a worm is to be found. I have always assumed that the worms were moving down-hill perhaps in search of water". The author states that others who have been in the Chin Hills District during the same months reported that all the migrating worms were of the same kind and were all going down-hill. The specimens collected were all *Perionyx* (possibly *P. excavatus*) without clitellum.

Protozoan Parasites of Fishes. R. R. Kudo (*Illinois Biol. Mon.*, **13**, No. 1, 1934) reports on a preliminary survey of the protozoan parasites of the fishes of Illinois. About 1,300 fishes belonging to 35 species and 13 families were examined, mainly for Protozoa attacking the tissues. The specimens of *Polyodon spathula*, *Lepisosteus osseus*, *Amia calva* and twenty-two other species were not infected but nine others belonging to the families Catostomidae, Cyprinidae and Siluridae were found to be common hosts of histozoic Protozoa, especially Myxosporidia, of which nineteen new species are described. In reservoirs near Peoria were observed large numbers of carp (*Cyprinus carpio*) suffering from an extremely heavy infection by a parasitic ciliate, *Ichthyophthirius multifiliis*. On the integument, gills and mucous membrane of the mouth cavity this ciliate was so numerous that the entire fish appeared whitish. In addition another ciliate, *Cyclochæta*, and a flagellate, *Costia*, were found abundantly in the lesions produced by the *Ichthyophthirius*, and the fishes appeared to be much weakened. *Ichthyophthirius* is world-wide in distribution and is often present in large numbers in fish kept in small aquaria, but it is unusual for such an epidemic to occur among fully grown fishes kept in large outdoor ponds.

A New Permian Fish. Mr. James Brough describes *Lekanichthys housei*, n.sp., a new dorypterid fish from the Permian (*Ann. and Mag. Nat. Hist.*, 10, **14**, No. 81, Sept. 1934) The family Dorypteridæ has up to the present only contained *Dorypterus* The new form displays many of the peculiarities of that genus, but shows clearly an intermediate grade of structure between the highly modified *Dorypterus* and the normal Palæoniscid The type specimen, which is unique, was collected apparently many years ago, and has since lain in the Hancock Museum, Newcastle-upon-Tyne. It was unlabelled, but Mr. Brough has little doubt as to the horizon from which it was obtained, as both fossil and matrix possess all the characters of the Marl Slate (Lower Permian), particularly as it occurs in the south of Durham County, and the specimen was probably obtained from this stratum in the Middridge-Thichley Area. The fish is well preserved Its general shape is similar to that of *Dorypterus*, showing specialisations of a like nature, but not developed to the same extent. In the characters in which it differs, it displays Palæoniscid affinities, and has therefore all the necessary qualities of a form ancestral to *Dorypterus* and intermediate in structure between it and the Palæoniscidæ, but, as the author states, this relationship is impossible since the remains are found in the same thin stratum, indicating that they lived side by side. He concludes that "*Lekanichthys* was a collateral ancestor—a form in the same group which either had evolved more slowly, or had reached a certain stage of specialisation and then halted, so that, although it is not a true ancestor, it reproduces the essential form of the ancestor at a certain stage".

Seasonal Variations of Carbohydrates in Fruit Trees. The second of a series of papers on "The Seasonal Cycles of Nitrogenous and Carbohydrate Materials in Fruit Trees" by members of the staff of Long Ashton Research Station (*J. Pomol. and Hort. Sci.*, **12**, No. 4, pp. 249–292, December, 1934) deals with the seasonal cycles of alcohol-soluble materials, of carbohydrate fractions and lignin in the wood, bark and leaves of terminal shoots of apple trees. Two cultural systems are involved, namely, trees grown on grassland, with annual dressings of nitrate in spring, and trees grown on arable land, without nitrogenous fertiliser. It is the work of Dr. Elsie S. Smyth. Well-defined seasonal variations in the amounts of all the carbohydrate fractions were found, and changes in the wood and bark were similar Difference in cultural treatment did not greatly affect the seasonal changes, though reducing sugars were rather more abundant in material from the arable plot in summer, than in trees grown on grass There were also differences in starch content. Carbohydrate-nitrogen ratios were, however, higher in the trees grown on grassland, than in the arable crop. Variations in the contents of alcohol-soluble matter, in reducing sugars, sucrose, starch, hemicellulose, total carbohydrates, cellulose and crude lignin, are all set out in detail.

A 'Traversing' Microscope. An example of a travelling or traversing microscope has been submitted to us for examination by Prof. E. W. Scripture, by whom it was designed for the examination and measurement of ordinates of curves having a considerable area, such as are obtained by tracings produced by changes of air pressure at the mouth during speech. It consists of a large rectangular base-plate of thick plate glass in metal frame supported on feet, which can be inclined if necessary so as to tilt it. The microscope barrel is held by a carrier which can be moved by means of racks and pinion-screws, so that it traverses 145 mm. back to front along a transverse bar, and 545 mm. longitudinally along a longitudinal bar. The bars are graduated, and by means of verniers, readings to 0·01 mm. can be taken. The verniers are provided with lenses for reading, and are illuminated by small electric bulbs worked off a dry cell, and opaque objects may be illuminated by a bulb attached to the microscope tube near the objective. For transparent objects, a sheet of white paper placed on the table beneath the base-plate usually suffices. The objects to be viewed can be clamped to the base-plate by longitudinal or transverse adjustable bars, or kept in place by a piece of glass laid upon them. While there is, perhaps, nothing very novel in design and construction, the instrument is noteworthy for the large area it can cover, and in addition to tracings is obviously adapted for the examination of large sections, membranes, fabrics, etc. The instrument is well constructed in white metal, and was made by Messrs. F. Homan, 13 Florence Road, S.E. 14.

Organic Sulphur Compounds. A paper by Messrs. F. Challenger and J. B. Harrison on sulphur compounds of technical interest, in particular the isomeric thiophthens, was read before a meeting of the Institution of Petroleum Technologists on January 8. Recently the occurrence of naphthalene, thiophen and thionaphthen in coal tar and Kimmeridge shale has led to the belief that thiophthen might also be an ingredient of similar substances, and the work undertaken on thiophthen and its derivatives and described in this paper was felt to be a necessary preliminary to proving or discounting that theory. Published technical data on these compounds are scanty. Various methods of preparation of thiophthen are reviewed and a precise account of that of Capelle, which was employed in this case, is given. In addition, notes are made on phenomena observed during reduction of solid thiophthen with sodium and alcohol and on the structure of the thiophthens as revealed by X-ray analysis. Part of the paper is devoted to reports of various experiments undertaken and apparatus and methods employed. These include purification of liquid thiophthen with mercuric chloride, preparation of liquid thiophthen with citric acid and phosphorus bisulphide, isolation of a by-product in the preparation of liquid thiophthen, oxidation and nitration of thiophthens, etc. Accounts are also given of the preparation of certain derivatives of isomeric thiophthens.

Cold Test for Fuels. Messrs. B. H. Moerbeek and A. C. Van Beest presented a paper on "Cold Test for Fuels" for discussion at a meeting of the Institution of Petroleum Technologists on January 8. Present methods of pour-point determinations of fuels were criticised and in particular the A.S.T.M. test was condemned on the grounds that results are dependent on the temperature at which the sample is preheated and on the thermal history of the batch of which it is part. Furthermore, maximum and minimum pour-point figures are returned which may lie far apart, and thus cause confusion in the mind of the consumer. The sensitiveness of residual fuels to their thermal history is attributed to the asphaltenes present, which are natural pour-point reducers, and experiments prove that their removal renders the fuel temperature-insensible. A new method of pour-point determination is therefore proposed which, it is hoped, will give more practical results. To this end the influence normally exerted by asphaltenes is eliminated by pre-heating followed by pre-cooling to such a temperature that the asphaltenes do not dissolve again. Results are returned in such a way as to indicate a temperature at which fuel can be shifted under a fixed pressure. The data collected as a result of these investigations are as yet insufficient to indicate whether the new method would be entirely satisfactory in practice; but there is enough information to arouse criticism and discussion of the principles involved.

Colour Indices of Stars in Open Clusters. A number of plates of open star clusters were taken by Prof. K. Lundmark at the Mount Wilson Observatory in 1922–23, using the 60-in. reflector with a wire grating placed in front of the mirror. These plates are now being measured by J. M. Ramberg, of the Lund Observatory, and a preliminary account of his results has just been published (*Lunds Medd.*, Ser. 2, No. 70). A brief account of the theory of obtaining effective wave-lengths from coarse-wire grating spectra is given, together with a description of the methods used in measuring the plates and correcting the results for various sources of error. The main object, however, was to standardise the measures for future work by comparing the resulting colour equivalents with the previously determined colour indices. For this purpose, five plates of Messier 37 were measured and the results correlated with colour indices by von Zeipel and Lindgren for stars in this cluster. The mean error of an effective wave-length was found to be ± 9·84 A., or ± 0·055 expressed in magnitudes. The final results are included in a catalogue giving the measured effective wave-lengths and calculated colour indices of 659 stars in Messier 37.

Nova Herculis. The *Observatory* of January publishes a summary of all further observations on this nova, which was discovered by Mr. J. P. M. Prentice, of Stowmarket, on December 13, 1934. The editors of the *Astronomische Nachrichten* have also published supplements and numbers containing short accounts of observations, sent in by numerous Continental observers. The nova when discovered had a visual magnitude of $2{\cdot}9^{m}$, after an initial decline, the magnitude rose to $1{\cdot}3^{m}$ on December 23. The brightness then declined sharply to $3{\cdot}4^{m}$ on December 26; it then increased very rapidly to $2{\cdot}6^{m}$ one day later. Since then there have been more fluctuations. The nova has exhibited characteristic spectra, namely, emission lines and bands due to hydrogen, helium and ionised metals, especially when decreasing in brightness. On December 20, when approaching maximum, the nova showed a spectrum which corresponded line for line with α Cygni (type *cA2p*). On December 23, the only marked emission line was $H\alpha$. On the other hand, on December 30, when the brightness had declined, the continuous spectrum had nearly vanished, leaving a strong emission band spectrum. The nova has been identified with a star of magnitude $15{\cdot}4^{m}$ on the Franklin Adams plates. There is some evidence to show that the star was a variable before the present outburst. An estimate of the star's distance, based on the intensity of the interstellar Ca^{+} lines, makes the distance 200 light years (a previous estimate was 2,000 light years).

Prize Awards for 1934 of the Paris Academy of Sciences

AT the annual public meeting of the Academy of Sciences the prize awards for 1934 were announced as follows:

Mathematics.—The Poncelet Prize to Maurice Fréchet for the whole of his mathematical work; the Francœur Prize to Jean Favard, for his work in mathematical analysis.

Mechanics.—The Montyon Prize to René Swyngedauw, for his studies on belts and ball bearings; the Fourneyron Prize to Robert Mazet, for his work on friction; the Henri de Parville Prize to Jean Leray, for his work on the mechanics of fluids.

Astronomy.—The Lalande Prize to Daniel Barbier, for his work on double stars; the Valz Prize to Ferdinand Quenisset, for his observations on comets; the Janssen Medal to Walter Sydney Adams, for his researches on stellar parallaxes.

Geography.—The Delalande Guérineau Prize to Jules Sion, for his work entitled "La France méditerranéenne"; the Gay Prize to Maurice Pardé, for his work entitled "Fleuves et rivières"; the Tchihatchef Foundation to Jean Gubler, for the publication of his work on the palæontology of Cambodia; the Binoux Prize in equal parts between Jules Schokalsky, for his memoir on the measurement of the lengths of rivers in Asiatic Russia, and Pierre Tardi, for his treatise on geodesy.

Navigation.—The Navy Prize to Jean Ottenheimer, for his work on ballistics and on submarine explosions; the Plumey Prize between René Anxionnaz (1,500 francs), for his work on internal combustion motors, André Chapelon (1,500 francs), for his work on the improvement of steam locomotives, and René Retel (1,000 francs), for his work on injection in Diesel motors.

Physics.—The L. La Caze Prize to Eugène Bloch, for the whole of his work in physics; the Kastner-Boursault Prize to Théodore Lehmann, for his work in electrotechnics and especially for his studies on tracing magnetic lines of force; the Hébert Prize to François Bedeau, for his "Traité de télégraphie sans fil" and for his researches on the methods of measurement with high frequency; the Hughes Prize to René Lucas, for his work in electro-optics; the Clément Félix Foundation to Marcel Laporte, for the continuation of his researches on the properties of the ions and on the electrical luminescence of gases.

Chemistry.—The Montyon Prize (Unhealthy Trades) to Paul Bruère, for his researches on individual or collective protection against poisonous gases or vapours; the Jecker Prize to Henri Hérissey for the whole of his chemical work; the L. La Caze Prize to Augustin Damiens, for the whole of his work; the Cahours Foundation to Louis Domange, for the continuation of his researches; the Paul Marguerite de la Charlonie Prize to Maurice Nicloux, for his work in chemical analysis; the Houzeau Prize to Georges Chaudron, for his studies on the reduction of the iron oxides and on their magnetic properties.

Mineralogy and Geology.—The James Hall Prize to Edouard Roch, for his work on the geology of Morocco.

Physics of the Globe.—The Victor Raulin Prize to Charles Poisson, for his work and publications on terrestrial magnetism and meteorology.

Botany.—The Desmazières Prize to René Dujarric de la Rivière, for his work entitled "Le poison des Amanites mortelles"; the Montagne Prize to Jules Lebasque for his work "Les champignons des teignes du cheval et des bovidés"; the de la Fons Mélicocq Prize to (the late) Pierre Jouane and Pierre Chouard, for their memoir "Essai de Géographie botanique sur les forêts de l'Aisne"; the de Coincy Prize to Maurice Lenoir, for his work on chromatines.

Anatomy and Zoology.—The Cuvier Prize to Jacques Pellegrin, for his ichthyological work; the Savigny Prize to Jacques Colas-Belcour, for his researches on the arthropods of North Africa; the Jean Thore Prize to Paul Vayssière, for his work on Coccideæ and the migratory Acridians.

Medicine and Surgery.—Montyon Prizes: Paul Armand-Delille, Charles Lestocquoy and René Huguenin (2,500 francs), for their work "La tuberculose pulmonaire et les maladies de l'appareil respiratoire de l'enfant et de l'adolescent"; Corneille Heymans, Jean Jacques Bouckaert and Paul Regniers (2,500 francs), for their work on the carotid sinus; Henri Lagrange (2,500 francs), for his book on ophthalmic studies. Honourable mentions (1,500 francs) to Félix Pierre Merklen, André R. Prévot and Jean Quénu. Citations to Hubert Jausion and François Pages, Carlos Lepoutre, Jean Quérangal des Essarts and Mme. Alix de Carbonnières de Saint Brice. The Barbier Prize to Georges J. Stefanopoulo, for his contribution to the study of yellow fever; the Bréant Prize between Constant Mathis (3,500 francs), for his memoir on recurrent spirochætosis, and Jacques Bailly (1,500 francs), for his work on hydrophobia; the Godard Prize to Mlle. Gilberte Pallot, for her study of microcystic ovaries; the Mège Prize to Pierre Lassablière, for his work entitled "Aliments, Régimes, Indications, Contre-indications"; the Bellion Prize to Jean Troisier and Yves Boquien, for their book on spirochætosis; the Jean Dagnan-Bouveret Prize to Auguste C. Marie and Paul Remlinger, for the whole of their work on hydrophobia.

Physiology.—Montyon Prize to Remy Collin, for his book on the hypophysis; the L. La Caze Prize to Paul Portier, for the whole of his physiological work; the Pourat Prize to Z. M. Bacq and Lucien Brouha, for their work on hormones; the Martin Damourette Prize to Edmond Benhamou, for his work on the spleen; the Philipeaux Prize to Georges Teissier for his morphological and physiological researches on the growth of insects.

Statistics.—The Montyon Prize to Pierre Jéramec (1,000 francs), for his work on statistics, and Louis Potin (1,000 francs), for his work in connexion with insurance risks.

History and Philosophy of Science.—The Binoux Prize between Paul Baud, for his book on chemical history in France, and Raoul Combes, for his history of plant biology in France.

Works of Science.—The Henri de Parville Prize to Jean Rostand (2,500 francs), for his books popularising general biology, and Pierre Sergescu (2,500 francs), for his book on the mathematical sciences.

Medals.—The Berthelot medal is awarded to Paul Bruère, Maurice Nicloux and Georges Chaudron.

Prizes Founded by the State.—The Grand Prize of the Mathematical Sciences to Emile Cotton, for the whole of his scientific work; the Bordin Prize to Pierre Frémy, for his work on the Myxophyceæ;

the Lallemand Prize to André Rochon-Duvigneaud, for his book on the eye and vision in the vertebrates: the Vaillant Prize to Henri Colin, for the whole of his work in plant physiology, the Hollevigue Prize to Léon Brillouin, for his researches and works on modern statistical mechanics, the Jean Jacques Berger Prize to Roger Boutteville, for his work in public lighting and hygiene, the Saintour Prize to Louis Dubertret, for his geological work and especially for his geological map of Syria, the Jules Mahyer Prize to Pierre Humbert, for the whole of his work in mathematical analysis, the Lonchamt Prize to Mme Marguerite Lwoff, for her memoirs on nutrition of the Trypanosomides, and André Lwoff, for his memoir on the significance of hæmoglobin for the flagellated parasites. the Wilde Prize to André Duparque, for the whole of his work on the structure and petrographical characters of coal, the Caméré Prize to Jean Aubert, for his work concerning a new system of mobile barrage, the Thorlet Prize to Paul Dorveaux, the Albert I of Monaco Prize to Jean Tilho, for his researches on the hydrography of the Lake Tchad region, the Marquet Prize to Frédéric Joliot and Mme Irène Joliot, for their discovery of temporary radioactivity

Special Foundations—The Lannelongue Foundation to Mme Gabriel Cusco, the Hélène Helbronner Fould Prize to Mme Pierre Savorgnan de Brazza

Grand Ecoles Prizes—The Laplace Prize to Jean Couture, the L. E Rivot Prize between Jean Couture, Louis Eyssautier, Michel Legrand and Yves Monneret

Grants for Scientific Researches—The Gegner Foundation to Camille Vallaux, for his oceanographic work, the Jérôme Ponti Foundation to Jean Thibaud, for his method of concentrating electrons in the magnetic field, the Hirn Foundation to Gonzague Dubar, for his work on the stratigraphy and palæontology of the Lias, especially in the Pyrenees and Morocco, the Becquerel Foundation to Yves Rocard, for his work on the kinetic theory of gases and on optics

The Loutreuil Foundation—Out of thirty five applications, the consulting committee has chosen the following

Researches on definite problems—Pierre Viala (6,000 francs), for his work on the parasite of the *Court Noué* of the vine; André Aron (2,000 francs), for his researches on the magnetic properties of thin sheets of nickel, James Basset (5,000 francs), for experimental researches on ultra-pressures, Paul Henri Fleuret (2,000 francs), for the study of ketogenesis and oxaluria Edmond Guillermet (3,000 francs), for his studies on electrolysis in solvents other than water, Mme Louis Nouvel (4,000 francs), for work in a maritime laboratory; Marcel Petit (4,000 francs), for his researches on the molars of Equideæ; Maurice Pierre (3,000 francs), for his researches on the rôle of the different physical and mechanical factors governing swallowing, vomiting and ruminating, Henri Simonnet (9,000 francs), for his researches in plant toxicology, André Wahl (3,000 francs), for the continuation of his work relating to tinctorial chemistry

Researches to be carried out in France overseas and countries under French mandate—Roger Heim (12,000 francs), as a contribution to the expenses of a voyage to Madagascar for the study of the cryptogamic flora and various diseases of trees and cultivated plants; Antoine Poidebard (7,000 francs), for his geographical studies by photography from the air in the Syrian desert

Purchase of Laboratory Material—René Dubrisay (10,000 francs), for the purchase of a Jobin and Yvon spectrograph

Publications—*Annales des sciences naturelles* (5,000 francs), for the publication of special volumes commemorating the centenary of this publication, Camille Arambourg (6,000 francs), for the publication of the scientific results of his Omo expedition; Comité de physique du globe des colonies (10,000 francs), for assisting the publication of its *Annales*, Fédération Française des Sociétés de sciences naturelles (5,000 francs), for the publication in the "Faune de France" of the memoirs of Seguy on the Acalypters and of Brolemann on the Diplopods

Grants to Libraries—Académie d'agriculture de France (5,000 francs), for assistance with its catalogue; Bibliothèque nationale et universitaire de Strasbourg (5,000 francs), for printing a catalogue of its periodicals, Ecole nationale vétérinaire de Lyon (5,000 francs), Ecole nationale vétérinaire de Toulouse (4,000 francs), Ecole Polytechnique (5,000 francs), Institut national agronomique (5,000 francs)

The Mme. Victor Noury Foundation to Raymond Poisson (3,000 francs), for his studies in protistology; Paul E. Thomas and Paul de Graeve (3,000 francs), for their work in biological chemistry, Mme. Edouard Salles (3,000 francs), for her studies on terrestrial magnetism; Edouard Lamy (2,500 francs), for the whole of his malacological work; Michel Volkonsky (2,500 francs), for his work in cytophysiology and plant physiology The Le Chatelier Foundation to René Paris, for carrying out researches on the devitrification of glass The Frément Foundation (2,500 francs) to Pierre Vernotte, for studies on the propagation of heat either by conduction or convection. The Roy-Vaucouloux Foundation to the Institut Marey.

Attacks of Birds upon Butterflies

CRITICS of the current theory of mimicry, but only so far as butterflies are concerned, claim that published records are insufficient to establish birds as the agents which may be considered mainly responsible for the production of mimetic resemblance in butterflies by preferential feeding. The following observation, communicated to me by Mr. T H E Jackson, of Kitale, Kenya Colony, is therefore of great interest to all students of natural selection. Early in the present year, at Bulumbe camp in Busia, in the eastern province of Uganda, he noted on the first night "a few wings of butterflies lying about but it was not until next morning that the truth dawned on me. I then found that the ground was literally strewn with wings There were four or five large *Spathodea nilotica* trees in the compound and swarms of butterflies were feeding on the flowers. Watching them that morning for birds I saw one swoop down on a *Papilio bromius* and take it off to a bare branch where it proceeded to beat off the wings, devouring the body only, and then returned to the tree for more. I made a list on paper of the butterflies present and only afterwards thought of collecting the wings themselves as evidence one *Acraea* we could not find again".

The following table gives Mr. Jackson's notes, together with the results of examining the wings sent by him. The number of *specimens* was reckoned by counting the maximum number of fore wings, right or left, whichever was the greatest

Species present	Prevalence	Wings found	Estimated (minimum) number of specimens eaten (by wings sent)
Papilionidae			
Papilio dardanus	Very common	Plentiful	Males, 5
Female form *hippocoonides*	About equal numbers seen or taken	A few	Female form *hippocoonides*, 2
,, ,, *planemoides*		None	
Papilio bromius	Very common	Plentiful	Males, 14 Females, 9 (An uneaten specimen with wings much torn also found)
Papilio nireus	A few	A few	Male, 1 Female, 1
Papilio phorcas	A few	A few	Males, 2 Female, 1 Female form *thersander*, 1
Pieridae			
Mylothris poppaea	Common	None	
Eronia thalassina	Common	Of two specimens	Males, 2
Eronia argia	A few	Of one specimen	Male, 1
Nymphalinae			
Charaxes brutus	A few *Charaxes* flying round trees and wings recovered of those mentioned, one or two of each		Male, 1
Charaxes castor			Males, 2
Charaxes etesipe			Females, 2
Charaxes tiridates			Female, 1
or *numenes*			Female, 1
Charaxes etheocles			Female, 1
Cyrestis camillus	Common, but lower down on under-sides of leaves	One or two	One
Precis westermanni	Common	A few	Male, 1
Acraeinae			
Acraea pharsalus,	Very common	Wings of three only discovered after very careful search	One male, whole except for head, and one right hind wing, of *A egina*
Acraea viviana			
Acraea egina			
Acraea encedon			

The following points deserve comment

(1) Several wings show such clear beak-marks that it was possible, through the kindness of Mr. N. B Kinnear of the British Museum, to compare them with imprints of the beaks of birds made by pinching soft paper between the mandibles, as was first suggested by Mr C L Collenette. The description of the birds given by Mr Jackson, whose ornithological knowledge unfortunately was not equal to his entomological, suggested a species of drongo "The birds were black and smallish without markings that one could distinguish . there were eight or nine of them." But impressions from drongos, or black flycatchers, were shorter and broader than the marks on the wings, and the nearest approach came from a species of *Lamprocolius* (glossy starling): the numbers also favour that rather than a species of drongo.

(2) Mr. Jackson noted that "the butterflies present were first Papilios and Acraeas in about equal quantities". The Papilios comprised several black and green species, and *dardanus* with cream coloured male and two forms of mimetic female The black and white *hippocoonides* resembles a species of *Amauris* (Danainae), the other, *planemoides*, has a conspicuous orange band producing a likeness to a *Planema* (*Acraeinae*). The males and black and white female were eaten, the other female was not "Both forms appeared to be equally common , we took four of the former and three of the latter, and saw one more of the latter. No models for either form were observed." The latter remark, of course, simply implies that the models were not feeding on the trees: *Amauris* is exceedingly common.

(3) Evidence that Acraeas are relatively distasteful is supplied by the small numbers of wings of these very common insects found on the ground One specimen "which is perfect except for the head was actually dropped at my feet under the tree while I was collecting the wings". It must be said, however, that the specimens sent comprised a *Papilio bromius*, the body of which was undamaged although the wings were torn *Acraea egina* is extremely abundant, black and scarlet , the less common *pharsalus* is of the same colour , *encedon* and *viviana* are yellowish or brownish , they have all the characters demanded of species relying upon brilliant colours to advertise distasteful qualities It is highly suggestive that the female *dardanus* which has an acraeine appearance was untouched

(4) The large bodied *Charaxes* (allied to our 'Purple Emperor' in habits) were evidently in demand, for wings of all the species seen were picked up This confirms the evidence of Mr C F M Swynnerton[1]

(5) Some of the 'Whites' (Pieridae) were common, but apparently not greatly in favour The two *Eronia* are white or greenish white , the *Mylothris* has a brilliant orange patch at the bases of the wings which is generally held to be an example of 'warning colour' , like *Acraea*, *Mylothris* is typically aposematic in habit, is mimicked by other butterflies, and is known by experimental evidence to be relatively distasteful It will be noted that *M poppaea*, 'common', was not attacked, while *Eronia* was.

(6) This most interesting and valuable observation does not support the statement so strongly emphasised by Mr. W L McAtee[2] that "predation takes place much the same as if there were no such thing as protective adaptations" and that "there is utilization of animals of practically every kind for food approximately in proportion to their numbers".

(7) Regarding published records, the difficulty has been in the past that many experienced naturalists have not thought it worth while to record the details of what they consider to be a "commonplace occurrence"[3] The Hope Department, Oxford University Museum, has put together a body of evidence in the form of beak-marks upon the wings, which are constantly being discovered now that their appearance is recognised During recent years, descriptions of many such have been published in the *Proceedings of the Royal Entomological Society of London*

(8) It has been said that migrations of butterflies should afford evidence, if butterflies are devoured by birds to an appreciable extent. Observations on this have been published, but attention may be directed here to notes in a recent book of travel[4]

G. D HALE CARPENTER.

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[1] Swynnerton, C. F M , Third Internat Ent. Congr , Zurich, 1925, Bd 2, Weimar 1926, 494–500

[2] McAtee, W L , *Smithsonian Misc Coll* , 85, No 7, 144, March 15, 1932.

[3] *Proc Ent Soc Lond* , 6, 34 , 1931.

[4] Puxley, W. L , "Wanderings in the Queensland Bush", p. 59 (London · G Allen and Unwin Ltd)

Rediffusion and Teleprogramme Systems in Broadcasting

'REDIFFUSION' is a method of distributing a broadcast programme over an independent line network to a number of subscribers. 'Teleprogramme' is the method which enables a telephone subscriber, by means of a small amount of additional apparatus, to receive the ordinary radio broadcast programmes over his telephone network The object of both systems is the same, namely, to reproduce the broadcast programme in the subscriber's home with the maximum fidelity , but the means employed are quite different.

A good paper by Mr A R A Rendall and Mr S Van Vierlo discusses the two methods in *Electrical Communication* of October Both methods are in use in various parts of the world In rediffusion, the programme is usually received by radio ; but it is better, when possible, to get direct reception from a studio. An amplifier station delivers the oscillations at such a level that all the subscriber needs to do is to bridge his loud speaker across the terminals The sounds are then heard at the proper loudness, no adjustment being necessary The choice of programmes is restricted, as although alternative programmes are easily provided, they add appreciably to the cost of the service Recently designed systems offer a choice of four programmes Considering this is all that is generally heard free from interference at an ordinary receiving set, this is satisfactory

The success of the system depends a great deal on the position chosen for the amplifier station and the cables used for connecting it with the consumers It should be near the centre of gravity of the load, and shielded cables should be used In these undertakings, the maintenance of a high and uniform standard in the quality of the reception is essential if they are to compete successfully with receiving sets, the prices of which are being continually reduced. A partial failure or even periods of poor quality would seriously affect their prospects of success

In a teleprogramme system, the radio broadcast is received on the subscriber's premises over his ordinary telephone network. This additional use of his telephone is sometimes a boon when it is not much used during the day and rarely in the evening It is obviously a serious inconvenience to have the programme interrupted by a telephone call Hence for subscribers with a high calling rate, an additional telephone cable is necessary to convey the programmes, and this adds to the expense. In most cases the subscriber has a choice between several programmes By controlling a step-by-step selector at the telephone exchange, he is able to get the programme he wants In this system it is necessary to limit the service to the normal speech level, and so an amplifier as well as a loud speaker has to be employed In the rediffusion system this is not necessary as the transmission level is much higher As the mere act of taking his receiver off the switch hook disconnects his amplifier, the subscriber can always use his telephone by interrupting the programme.

When considering the apparatus necessary for the supply of a group of 500 subscribers, it is customary to assume that not more than 60 per cent of them will be connected to a particular programme at the same time. In this case the amplifiers are usually rated for a power varying from 2 to 40 watts

University and Educational Intelligence

CAMBRIDGE —Mr W V D Hodge, University lecturer in mathematics, has been elected into a fellowship and appointed lecturer and director of mathematical studies at Pembroke College Mr. Hodge was educated at George Watson's College, Edinburgh, the University of Edinburgh and St John's College, Cambridge He obtained a first class in Part 2 of the Mathematical Tripos in 1925 and was awarded a Smith's Prize in 1927 He also studied at Princeton University while holding a Senior 1851 Exhibition in 1926-31 He was on the staff of the University of Bristol and held a fellowship at St. John's College from 1930 until 1933.

EDINBURGH —The Cameron Prize for 1935 has been awarded to Prof Julius Wagner Jauregg, emeritus professor of psychiatry and neuropathology in the University of Vienna, in recognition of his discoveries regarding the malarial treatment of general paralysis

LONDON —The following titles have been conferred in respect of posts held at schools of the University . professor of chemistry, Dr J W Cook, the Cancer Hospital (Free) , reader in organic chemistry, Dr G A R Kon, Imperial College—Royal College of Science

The William Julius Mickle fellowship for 1935 has been awarded to Dr Solly Zuckerman

The Carpenter Medal for 1934 has been awarded to Dr R J Lythgoe

MANCHESTER —Dr A H Gibson, Beyer professor of engineering, has been appointed a pro-vice-chancellor, for a period of two years as from January 23, 1935, on the resignation of Prof Lapworth

Dr. F P Burt, reader in stoichio-chemistry, has been elected dean of the Faculty of Science for two years from January 1935

Dr W N Bailey, senior lecturer in mathematics, has been appointed Richardson lecturer in pure mathematics

The Research and Standardisation Committee of the Institution of Automobile Engineers has presented to the Engineering Department an experimental petrol engine, and Mr Charles Day, of Messrs. Mirrlees, Bickerton and Day, Limited, has loaned a Ricardo Diesel engine complete with all testing equipment

THE American adult educational enterprise known as "The University of the Air" is now entering upon its third year Prof John Dewey, addressing an audience of sixteen hundred on December 8 at New York City Hall on "Radio's Influence on the Mind", claimed for broadcasting that it is the most powerful instrument of social education the world has ever seen and one urgently needed to redress the balance between the modern means of exchange of physical things and those of knowledge and ideas. One of the most crucial problems of to-day is how to ensure the employment of this instrument for the social public interest, in preference to its use for propaganda designed to distort facts and mislead the public mind The 1935 programme embraces talks on : education for a new social order, economic planning, psycho-analysis and studies in a museum.

THAT biology should be taught in all schools to all pupils is one of the conclusions of the argument developed by Dr C J Bond, Fernshaw, Springfield, Road, Leicester, in an address delivered to Section L at the Aberdeen meeting of the British Association last year The address is now obtainable in pamphlet form Young people suffer to-day from no sound biological foundation having been laid during school life for, at any rate, three departments of life in civilised societies (1) sex, marriage and parenthood, (2) citizenship, (3) vocation For (1) the foundation should include instruction in the general principles of genetics, including human heredity, with examples drawn from plant and animal life, and wise advice and guidance should be made available during school life and to young persons of both sexes who wish to marry As regards citizenship, our present system of national education is marred by a lack of continuity and completeness answerable for the existence of a false conception in many minds of the real nature of individual liberty and of conflict of individual, social and racial interests Vocational guidance is obviously more important for the welfare of the young citizen and prevention of waste of human capacity than examination of scholastic acquirements It can only be given by skilled experts able to assess natural aptitudes and equipped with technical knowledge of the conditions and requirements of the diverse occupations open to 'school leavers', and this combination of psychological and technical knowledge must be acquired during and after the period spent in teacher training colleges by teachers specially interested in industrial life and vocational guidance. The address touches also on the steadily increasing ratio of old to young in the population, on biology and culture, on education in the right use of leisure and the limits of what can be achieved by education.

Science News a Century Ago

The Linnean Society

On February 3, 1835, at a meeting of the Linnean Society at which A B Lambert was in the chair, B H Hodgson, Dr Kidd of Oxford and R. Garner, whose paper "On the Nervous Structure of Molluscous Animals" had lately been read, were elected fellows of the Society. The secretary read a paper by Mr Bentham of the Horticultural Society "On the Various Species of the Genus *Lotus*, and the Allied Genera". The chairman exhibited the flowers and leaves of *Dracæna terminalis*, a plant from the islands of the Pacific successfully cultivated at his own residence in Wiltshire The flowers were used by the natives of the islands, he said, to flavour a liquid like beer, and the fibres of the long leaves served as threads. Profs Bartoloni, Fries, Harlan, Harrold, Lichtenstein and Reinwardt, with Baron Delessert, were nominated to fill the vacancies in the list of foreign members

Meteorology at the Cape of Good Hope

Writing from Edinburgh on February 5, 1835, to Sir John Herschel at the Cape, J. D Forbes said . "I had a letter from Whewell the other day, communicating your obliging message to me about your very interesting meteorological results. . . The annual variation of mean pressure and also of hourly oscillation you mention is noticed by Humbolt in equatorial climates. Is the barometer highest in summer or winter ? I fear we are likely to find little analogous to your observations at the Cape in the Mediterranean The oscillation is undoubtedly greater and I do not think the barometer is highest in bad weather The variable pressure in different latitudes is a very important and to me, till lately, an unexpected fact I hope that you will be able to bring your barometer safely home again, and so determine the height of your observatory I hope you have your actinometer with you , here it has a sinecure, there being no sun worth measuring "

Henry's Electrical Experiments

On February 7, 1835, Prof A D. Bache wrote to the Committee of Publications of the Franklin Institute saying that "The American Philosophical Society, at their last stated meeting, authorised the following abstract of a verbal communication made to the Society by Professor Henry on the sixteenth of January last A memoir on this subject has been since submitted to the Society containing an extension of the subject, the primary fact in relation to which was observed by Professor Henry as early as 1832, and announced by him in the American Journal of Science Mr Faraday having recently entered upon a similar train of observations, the immediate publication of the accompanying is important, that the prior claims of our fellow countryman may not be overlooked" Bache's letter was followed by an abstract from the report of the meeting of the American Philosophical Society which contained details of Henry's experiments with electric currents

Death of Baron Dupuytren

On February 8, 1835, Baron Guillaume Dupuytren, the foremost surgeon in France, died in Paris Born in humble circumstances at Pierre Buffière in Limousin on October 6, 1777, it is said that he was stolen when three by a lady of rank, but was afterwards recovered by his parents Both in appearance and by his conversation he attracted the attention of people, and at the age of twelve years through the action of an army officer he was sent to the Collège de la Marche in Paris, and his youth was thus passed amidst the turmoil of the French Revolution Subsisting on the most meagre of allowances, he was, however, able to study chemistry and anatomy and at the age of seventeen years, in 1794, obtained a post in the new School of Medicine founded under the direction of Fourcroy. From then his progress was unchecked In 1803 he was made an assistant surgeon at the Hôtel-Dieu, in 1811 succeeded Sabatier in the professorship of operative surgery and in 1815 he was given the chair of clinical surgery, which he held until his death. He was also surgeon to Louis XVIII "Haughty, austere, and brooking no rivals," says Seelig, "he trod through life always upwards, charming by his very disdain and constantly introducing technical innovations that have stood the test of time. By a queer twist of fate, one of the least significant of his accomplishments, a description of contracted palmar fascia, is the one to which his name has clung". The perseverance he had shown amid the difficulties of his early years was not more notable than the assiduity with which he always carried out his duties and the iron resolution which astonished all who came in contact with him He was buried in the Père Lachaise cemetery, and a part of his large fortune was used for the founding of the Musée Dupuytren near the École de Médicine, Paris.

Societies and Academies

LONDON

Royal Society, January 24. M BORN and L INFELD On the quantisation of the new field equations (1) The new field theory uses the primary field vectors **E**, **B** and derives secondary field vectors **D**, **H** by differentiating the Lagrangian L (**E**, **B**) with respect to **E**, **B**. If one gives up the invariant form (that is, the four dimensional tensor notation), one can introduce other pairs of primary variables, in each case there exists an action function, one of which is the energy density Using this representation it is possible to formulate the quantum laws of the field The field equations can be written without any space or time derivatives, only by means of commutators connecting the field vectors with the total energy and the total momentum They formulate a coherent unitarian quantum theory of matter and field (2) The commutation rules for the field components are given in a new form which makes no use of δ-functions The behaviour of an electrodynamical system as a whole is described by a set of integral quantities total energy, total momentum, centre of energy, total angular momentum These quantities satisfy commutation rules which can be derived from those for the field components The chief result is that the co ordinates of the centre and the components of the total momentum are connected by the same commutation laws as in quantum mechanics, and that the components of the momentum commute, but the co-ordinates of the centre do not commute H BETHE and R PEIERLS The scattering of neutrons by protons The result is practically independent of the special law of force assumed between neutron and proton, it depends only upon the known binding energy of the diplon. The cross-section obtained is about 50 per cent larger than the rather uncertain experimental value. The scattering is almost isotropic (in the relative coordinate system) for neutron energies up to about 40 million volts

EDINBURGH

Royal Society, January 7. ESTHER LOWE. Anatomy of a marine copepod, *Calanus finmarchicus*, Gunner. A muscular mechanism in the heart wall opens the aortic valve and closes the ostia during systole Circulation is assisted by rhythmical movements of the pericardial floor, involving alternate contraction of two sets of muscles A paired series of canals returns blood to the pericardium A pair of giant fibres in the nerve cord, arising by a chiasma in the brain, give off branches supplying, alternately, the dorsal longitudinal trunk muscles, which determine direction, and the flexors of the swimming feet, which accomplish the darting movement The system, evidently, constitutes the effector portion of an escape reflex. GERARD DE GEER: Dating of lateglacial clay varves in Scotland. A measurement by Dr. J. B Simpson of varved clay exposed by the River Earn near Dunning, Perthshire, has been correlated with a series from Lyngby, near Copenhagen. According to this correlation, the Dunning section corresponds to an early stage in the gotiglacial sub-epoch of the Scandinavian ice-retreat, dating from about 13,000 years ago J. WALTON: The fossil hollow trees of Arran and their branches, *Lepidophloios Wünschianus*, Carruthers In 1865, Edward A. Wünsch, of Glasgow, made the interesting discovery that there were fossil trees in position of growth in the Lower Carboniferous volcanic ash beds on the north-east coast of Arran in the Clyde. The new methods which are available for getting sections of fossil plants are such that there is almost no limit to the size of block of material from which a section may be prepared The trees had partly decayed before preservation and the hollow trunks contain fragments of many different kinds of plants (for example, *Bothrodendron*, *Protocalamites*, *Lyginorachis*), all very well preserved structurally The trees themselves prove to belong to the genus *Lepidophloios*, a near ally of the better-known Carboniferous genus *Lepidodendron*. Only the bases of the trunks are preserved In four examples the central core of wood is found, and from its structure something of the mode of growth of the original tree may be deduced. It is also evident that, like the nearest living representatives of this extinct genus, *Selaginella* and *Isoetes*, these gigantic trees developed from spores By careful comparison of histological features, it has been possible to identify various sized branches and twigs found in the same beds as parts of the plant which possessed the large trunks IAN SANDEMAN The mathematical representation of the energy levels of the secondary spectrum of hydrogen (2). An analysis of the two states, $1s2s\,{}^3\Sigma$ and $1s2p\,{}^1\Sigma$, of H_2 is carried out on the basis of J L. Dunham's solution of the wave-mechanics equation for the diatomic molecule The consistency of the results indicates very little evidence of l uncoupling for these states Potential functions are obtained which indicate that the potential function of Morse is not applicable to the two states

PARIS

Academy of Sciences, December 26 (*C R*, **199**, 1537–1694) The president announced the death of Willem de Sitter, *Correspondant* for the Section of Astronomy JEAN CHARCOT Notice on the works of M de Gerlache A LACROIX. The discovery of tectites on the Ivory Coast Description and analyses of three specimens of tectites from West Africa H DESLANDRES: A simple and general relation of the molecular spectrum to the electrons and rings of electrons of the constituent atoms JULIEN COSTANTIN, JOSEPH BOUGET and JOSEPH MAGROU: New experiments on the germination of the seeds of the potato in the mountains (1934) Comparison of the results of the culture experiments in 1933 and 1934. HYACINTHE VINCENT: Streptococcæmia and suppurating meningitis with streptococci The action of antistreptococcus serum in these infectious states. The author considers that the value of his serum treatment is best tested on the most serious forms of streptococcal infection, septicæmia and suppurating meningo-cephalitis. Of 218 such cases, 180 were cured CHARLES NICOLLE and PAUL GIROUD The observation of the Tunisian epidemics of historic and murin typhus and the study of their virus, showing that these two diseases are separate CHARLES CAMICHEL and LÉOPOLD ESCANDE. The linear elements produced by the movements of fluids in the interior of systems under pressure J SCHOKALSKY: The physical map of the north polar region. LÉON POMEY: The last theorem of Fermat (divisibility by 3 and 5). N ARONSZAJN: The series of Dirichlet with exponents linearly independent JULES SCHAUDER: Quasi-linear equations of the elliptic type with continued coefficients. M. GHERMANESCO: The exceptional surface of a system of integral functions. SILVIO MINETTI: Some points of the theory of functions

Henri Mineur. Mechanical systems in which the parameters are functions of the time **Henri Poncin**. The stable hydrodynamical configurations which allow surfaces of discontinuities for the densities. **Marius Aubert, Pierre Clerget** and **Roger Duchêne** Detonation in injection motors Description of an arrangement permitting the kinematographic study of flame propagation in a cylinder with two jets. Simultaneous injection of alcohol with gas oil reduced detonation, and benzaldehyde showed an even more marked antidetonating effect. **André Danjon** A new transit instrument. This new form requires no essential geometric linkage, the meridian being defined by an optical method The instrument has been used for some months at the Strasbourg Observatory The corrections given by zenithal and equatorial stars do not show the systematic deviations of some hundredths of a second found with transit instruments of the ordinary type **H Grouiller**: Photographic stellar photometry by the method of Ch. Fabry. The method proposed by Fabry in 1910 has been applied to an equatorial at the Lyons Observatory and a diagram is given showing the light curve of the variable star *RT* Aurigae **Charles Bertaud** The spectrum of Nova Herculis **Jean Lagrula**. Measurements of the intensity of gravity in northern Africa **P. Lejay**: The general characters of gravity along the southern coast of China **Nicolas Kryloff** and **Nicolas Bogoliuboff**· The quasi-periodic solutions of the equations of nonlinear mechanics **Jean Louis Destouches** The centre of gravity in Dirac's mechanics. Application to photons, to spin and to the proton **Max Born** and **Léopold Infeld** The deduction of Dirac's wave equation starting from quantic electrodynamics **C Budeanu**: The working of a deforming apparatus **Y Rocard** The transfers of modulation in the Heaviside layer **Pierre Jacquinot**. The Zeeman effect of mercury and its perturbations **Georges Athanasiu** Photo-voltaic batteries and photoelectric cells with boundary layer. **Pierre Gabiano** The natural and magnetic rotatory powers of pinene vapour The specific rotatory power of pinene as vapour is identical with that of the liquid, but the magnetic rotatory power of this hydrocarbon as vapour is 0·77 that of the liquid. **Pierre Auger** and **Paul Ehrenfest**· Ultra-penetrating corpuscles of the cosmic radiation **Wilfried Heller**· The frequency of the rotation and vibration bands and the chemical activity of molecules in the gaseous state **A Portevin** and **D Seferian**: The absorption of nitrogen by the fusion of iron in the arc, and the iron-nitrogen diagram Description of the proportions of iron nitride formed under different conditions of heating 0 25–0·4 per cent nitrogen is absorbed when iron is fused in the flame of atomic nitrogen. The results of micrographic, dilatometric and thermo-magnetic study of the specimens are given in diagram form

(*To be continued*)

ROME

Royal National Academy of the Lincei: Communications received during the vacation of 1934. **G. A Crocco**: The conception of 'focus' in the stability of aeroplanes **A. Russo**: Elimination of nuclear substance and adhesion of the gametes in a ciliate, in relation to the agglutination in the fertilisation of Metazoa. **S. Sarantopoulos**: A theorem concerning the method by recurrence (complete induction). **G. Belardinelli**: A class of analytic functionals (1). **N. Moisseiev**: The curves defined by a system of differential equations of the second order (2). Certain properties of the trajectories in Hill's problem of three bodies. Previous study of dynamic problems with two degrees of freedom revealed the existence, on the plane of motion, of a geometric locus of the points in which occurs contact of the trajectories with a given family of curves, $f(x, y) =$ constant This contact was not lower than the second order Such a curve is now applied to the study of the properties of the trajectories in Hill's problem (3) Concerning a method of studying the integral curves in the system of three differential equations of the second order **G L Andrissi**: Measurements of double stars Measurements made on a number of double stars from Burnham's "General Catalogue of Double Stars" (1906) by means of the 7-inch Cauchoix-Cavignato equatorial at the Campidoglio Observatory are recorded **A G Barbieri** Compounds intermediate to ferrocyanides and ferro ammines When treated with potassium cyanide, ferro-dipyridyl and ferro-phenanthroline compounds of the type $[FeB_3]X_2$ ($B = \alpha\alpha^1$-dipyridyl or *o*-phenanthroline) yield ferrocyanide, with intermediate formation of compounds of the structure $\left[Fe^{B_2}_{(CN)_2}\right]$ and $\left[Fe^{B_1}_{(CN)_4}\right]K_2$, containing either two or three molecules of water of crystallisation **G. Scagliarini** and **M. Ragno** Influence of temperature on the formation of additive compounds In the cold, cobalt chloride and bromide react with pyridine, giving the compounds $CoCl_2, 4C_5H_5N$ and $CoBr_2, 4C_5H_5N$. If, however, the solutions are kept for some hours at 70°–80°, the salts crystallising out contain only two molecules of pyridine per molecule of the cobalt salt. Other similar cases are recorded **Carmela Manunta**. Origin of the uric acid in the hibernating eggs of the silkworm. Experimental data confirm the hypothesis that this uric acid is derived largely, not from embryonal metabolism, but from the maternal blood

VIENNA

Academy of Sciences, November 29 **Richilde Wagner** Admittance of radium emanation into the human body through the skin The skin is slightly permeable to the emanation but this is, as a rule, not the chief means of access of the emanation to the organism from baths **Max Pestemer** and **Bruno Litschauer**. Ultra-violet absorption of mustard oil and of the thiocyanate group. This absorption is determined mainly by the sulphur atom of the thiocyanate and isothiocyanate group **Max Pestemer** and **Gerhard Schmidt**: Ultra-violet absorption of binary liquid mixtures (6): the system ethyl thiocyanate – hexane. The curves representing the extinction coefficients of these mixtures are positive in comparison with those calculated additively. **Paula Bernstein**: Ultra-violet absorption of the system aniline – *m*-cresol in ethanol. In 0 01 and 0·1 molar solutions, the extinctions of these mixtures are virtually additive, although an equi-molecular compound is formed; such compound apparently decomposes at the above dilutions **Max Pestemer** and **Bruno Litschauer**· Ultra-violet absorption of the system acetone – benzene In agreement with the results obtained for the system acetone – hexane, the extinction of the acetone is positive in comparison with the additive values for the mixtures. That of the benzene is, however, negative, probably owing to an inductive action of the polar acetone.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, February 3

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 -- "The Interrelationship of Plants and Animals" (Parts 1 and 2) *

Monday, February 4

SOCIETY OF ENGINEERS, at 6 —Inaugural meeting for 1935 Col H C Hawkins Presidential Address

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —Eric Shipton "Nanda Devi and the Ganges Watershed"

Wednesday, February 6

ROYAL SOCIETY OF ARTS, at 8 30 —Sir Frederick Cowland Hopkins "The Study of Human Nutrition—the Outlook Today" (Sir Henry Trueman Wood Lecture)

BRITISH SCIENCE GUILD AND ROYAL INSTITUTION, at 9—(at the Royal Institution)—Dr C H Desch "The Microscope and Metal Industries" (Research and Development Lecture)

Thursday, February 7

ROYAL SOCIETY, at 4 30 —Prof E N da C Andrade and P J Hutchings "The Mechanical Behaviour of Single Crystals of Mercury"

Prof E N da C Andrade and J C Martindale "The Structure and Physical Properties of Thin Films of Metals on Solid Surfaces"

Dr M Born 'On the Theory of Optical Activity"

LINNEAN SOCIETY OF LONDON, at 5 —Exhibition meeting

CHEMICAL SOCIETY, at 8 —Discussion on "Intermetallic Compounds" to be opened by Dr C H Desch

Friday, February 8

ROYAL ASTRONOMICAL SOCIETY, at 5 -Annual General Meeting Prof F J M Stratton Presidential Address

ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE (BEDSON CLUB), at 6 30 —Prof C R Harington "The Biochemistry of the Thyroid Gland" (Bedson Lecture)

ROYAL INSTITUTION, at 9 —Sir Gilbert Walker "Clouds —Natural and Artificial"

Saturday, February 9

SCHOOL NATURE STUDY UNION, at 3 —Annual Conference to be held at University College, Gower Street, London, W C 1

Prof Winifred Cullis (President-Elect) "Biology and the Community"

Official Publications Received

GREAT BRITAIN AND IRELAND

The University of Manchester The Manchester Museum Museum Publication, No 107 Report of the Museum Committee for the Year 1933–34 Pp 22 (Manchester) 6*d* net

Proceedings of the Royal Irish Academy Vol 42, Section B, No 6 Reports from the Limnological Laboratory, 3 The Food and Growth of Brown Trout from Lough Derg and the River Shannon By R Southern Pp 87–172+3 plates (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 3*s*

Abstracts of Dissertations approved for the Ph D , M Sc and M Litt Degrees in the University of Cambridge during the Academical Year 1933–1934 (Published by Authority) Pp 102 (Cambridge Printed at the University Press)

Ministry of Health Report on the Work of the Central Midwives Board for the Year ended 31st March 1934 Pp 18 (London H M Stationery Office) 3*d* net

University of Reading Faculty of Agriculture and Horticulture Bulletin No 48 A Soil Survey of the Eastern Portion of the Vale of the White Horse By Dr F F Kay Pp 187 (Reading)

The University of Leeds Department of Coal Gas and Fuel Industries (with Metallurgy) Report of the Livesey Professor (John W Cobb) for the Session 1933–34 Pp 12 (Leeds)

War Office Report on the Health of the Army for the Year 1933 (Vol 69) Pp iv+154 (London H M Stationery Office) 2*s* 6*d* net

OTHER COUNTRIES

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 145 Contribution to a Knowledge of the White Flies (*Aleurodidæ*) of Egypt, (3) By Prof Dr H Priesner and Mahmoud Hosny Pp ii+10 plates 5 P T Bulletin No 148 The Nature of Soil Deterioration in Egypt By David S Gracie, Mahfouz Rizk, Ahmed Moukhtar, Abdel Hamid I Moustafa Pp ix+22+8 plates 4 P T (Cairo Government Press)

Conseil Permanent International pour l'Exploration de la Mer Bulletin statistique des pêches maritimes des pays du Nord et de l'ouest de l'Europe Redigé par D'Arcy Wentworth Thompson Vol 22 Pour l'année 1932 Pp 79 (Copenhague Andr Fred Høst et fils) 3 00 kr

The Indian Forest Records Vol 20, Part 12 New Ichneumonidæ from India and China By R A Cushman Pp 8 4 annas , 5*d* Vol 20, Part 14 Interim Report on Work under Project 8 (Testing of Indian Timbers for Veneer and Plywood) By W Nagle Pp iv+56+3 plates 1 rupee , 1*s* 9*d* (Delhi Manager of Publications)

The South African Journal of Science Vol 31 Being the Report of the Thirty second Annual Meeting of the South African Association for the Advancement of Science, Port Elizabeth, 1934, 2 July to 7 July Pp xxxvii+618 (Johannesburg) 30*s* net

India Meteorological Department Scientific Notes, Vol 5, No 58 On Forecasting Weather over Northeast Baluchistan during the Monsoon Months, July and August By A K Roy and R C Bhattacharya Pp 125–131 (Delhi Manager of Publications) 4 annas , 5*d*

U S Department of the Interior Geological Survey Professional Paper 185-D A Flora of Pottsville Age from the Mosquito Range, Colorado By Charles B Read (Shorter Contributions to General Geology, 1934–35) Pp ii+79–96+plates 16–18 (Washington, D C Government Printing Office) 10 cents

U S Department of Agriculture Circular No 319 Fertilizer Studies with Sugar Beets in the Arkansas Valley Area, Colo , 1921–28 By L A Hurst and A W Skuderna Pp 20 (Washington, D C Government Printing Office) 5 cents

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 86 Castilleja in Alaska and Northwestern Canada By Francis W Pennell Pp 517–540 (Philadelphia)

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès-verbaux des réunions, Vol 92 Salmon in the Baltic Precincts By Gunnar Alm Pp 63 (Copenhague Andr Fred Høst et fils) 3 00 kr

Society of Biological Chemists Industrial Possibilities of some Research Work done in India By Dr Gilbert J Fowler Pp ii+42 (Bangalore Indian Institute of Science) 1 rupee

Observatoire de Paris Section d'Astrophysique, à Meudon Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure Par L D'Azambuja (Vol 1, Fasc 1 Année 1931) Pp 40 Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure Par L D'Azambuja (Vol 1, Fasc 2, Année 1932) Pp 32 (Meudon)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 115 Jahresversammlung vom 6 bis 9 September 1934 in Zürich Pp 550+69 (Aarau H R Sauerländer et Cie)

Dominion of Canada Seventeenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement 1933–1934 Pp 149 (Ottawa)

University of Toronto Studies Geological Series, No 36 Contributions to Canadian Mineralogy, 1934, from the Department of Mineralogy and Petrography, University of Toronto Pp 56+6 plates (Toronto University of Toronto Press) 50 cents

Brooklyn Botanic Garden Record Vol 24, No 1 Delectus Seminum, Brooklyn 1934 Pp 10 (Brooklyn, N Y Brooklyn Institute of Arts and Sciences)

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 84 The Basal (Standard) Metabolism of the Australian Merino Sheep, II By A W Peirce Pp 22 Bulletin No 85 Studies on the Phosphorus Requirements of Sheep, II The Effect of Supplying Phosphatic Supplements to Growing Lambs depastured on Phosphorus-Deficient Country 1 The Effects of allowing Growing Merino Sheep Free Access to Phosphatic Licks while depastured on a Phosphorus-Deficient Area at "Dismal Swamp" South Australia, by H R Marston , 2 Field Management of the Experiment, by E W Lines , 3 A Soil Survey of the Area under the Control of the Division of Animal Nutrition at 'Dismal Swamp by T J Marshall and J S Hosking Pp 22 Pamphlet No 50 The Design of Overhead Irrigation Systems By E S West and A Howard Pp 39+6 plates (Melbourne Government Printer)

Proceedings of the American Academy of Arts and Sciences Vol 69, No 9 A Study of the Ant Genera Novomessor and Veromessor By William Morton Wheeler and William Steel Creighton Pp 341–387+2 plates 90 cents Vol 69, No 10 Contribution from the Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, No 333 The Apparatus and Method used for the Measurement of the Compressibility of Several Gases in the Range 0° to 325° C By James A Beattie Pp 389–405 45 cents (Boston Mass)

Western Australia Annual Progress Report of the Geological Survey for the Year 1933 Pp 16 (Perth Government Printer)

CATALOGUES

Sciences occultes (Catalogue No 2) Pp 44 (Paris Émile Offenbacher)

Dawson's Periodica (Catalogue N S No. 15) Pp 28 (Catalogue N S No 16) Pp 20 (London Wm. Dawson and Sons, Ltd)

Catalogue of Books and Journals bearing on Medicine and Surgery and the Allied Subjects (No 447) Pp 34 (Cambridge W Heffer and Sons, Ltd)

Chloramine Antiseptics—Boots Pp 16 (Nottingham Boots Pure Drug Co , Ltd)

Books and Periodicals on Natural History (New Series, No 38) Pp 48 (London Wheldon and Wesley, Ltd)

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The Planting of Hardwood Trees

RECENT correspondence in the Press, to which Mr. Alexander Howard refers in a letter on p 231 of this issue, has directed attention to the alarming rate at which hardwood trees, whether isolated or in hedgerows, woodlands or otherwise, are being felled in many parts of Britain without any attempt at replanting Various reasons for this state of affairs might be given, including high taxation, which has forced landowners to realise every possible tree in an endeavour to retain possession of their property, the general depression, the break-up of estates, the high level of wages, the remoteness of prospective yields and uncertainty as to the future, which prevent landowners from sinking capital in long-term investments such as plantations On the other hand, it should be mentioned that recent legislation provides a large measure of relief in regard to taxation and death duties, among other things, for purposes of probate the value of woodlands is excluded from the total value of an estate, and a landowner therefore stands to benefit his estate by storing up capital in the form of growing timber.

It will be convenient if we approach this question from two points of view, the æsthetic or sentimental on one hand and the economic or utilitarian on the other These are not necessarily antagonistic Opinions on the æsthetic value of different classes of trees are governed so much by personal taste or sentiment that agreement on the subject can scarcely be expected But misdirected sentiment has been responsible for some confusion of ideas. Some writers advocate the wider use of our 'native hardwoods', but include among them various introduced species, such as the 'common' elm, the sycamore, the lime, the walnut and others At the same time, they have condemned the use of conifers, partly for æsthetic reasons and partly because all our coniferous timber trees except the Scots pine are exotics. This attitude is scarcely reasonable, for among the conifers are to be found some of the most beautiful and interesting trees in the world. Let it be admitted, therefore, that conifers, when used with discretion, have their æsthetic value as well as hardwoods But when we find, as we now do, that the hardwood trees which have been the glory of English scenery in the past are being extensively felled, and if replaced at all are being replaced mainly by conifers, it is time to call a halt. Here we touch the economic and utilitarian side of the question

So far as requirements in bulk are concerned, coniferous timbers (softwoods) are of much more importance than hardwoods They constitute about eighty per cent of the world's consumption of sawn timber, and are used in large quantities for pitprops, telegraph and other poles, paper-pulp and other purposes Owing to the depletion of the world's timber resources, a serious shortage of softwoods within a measurable period of time is predicted, though hardwoods in general will not be affected to anything like the same extent It is partly for this reason that in the programme of State afforestation proposed by the Acland Committee of 1916–17, and now being carried out by the Forestry Commission, the area to be afforested with conifers was estimated at 1,770,000 acres and that required for hardwoods at only 100,000 acres, or about 5 3 per cent of the total This policy has been modified recently in favour of an increased use of hardwoods for afforestation in localities suitable for them, and actually more than six per cent of the total area afforested to date has been planted with hardwoods The planting of hardwoods, however, is restricted by the fact that the price to be paid by the Commissioners for land is fixed at a comparatively low figure This means that much of the land acquired is too poor for the cultivation of the more valuable hardwoods, and is fit only for the less exacting conifers. Nevertheless, in areas planted with conifers steps are being taken, on æsthetic as well as on sylvicultural and protective grounds, to introduce broad-leaved trees along the sides of roads, and even within the plantations.

That the private landowner should replace the previously existing hardwood crops by coniferous plantations is not altogether surprising The latter may possibly yield returns within the lifetime of himself or his heir, but there is small hope of this in the case of the former, if we exclude such short-rotation crops as chestnut coppice and the like Leaving æsthetic and sentimental considerations out of account, therefore, are there any economic or technical reasons why hardwoods should continue to hold an important place in British forestry? The answer to this question is a decided affirmative. Although the total consumption is considerably less in the case of hardwoods than of softwoods, there are many special purposes for which hardwoods, and definite species of hardwoods, are alone suitable , and it is important that future supplies of such woods should be ensured. Again, extensive afforestation with introduced conifers is attended with considerable risk from insect pests and fungus diseases, particularly in a country like England, the natural forest vegetation of which consists predominantly of broad-leaved trees France is now learning this to her cost in the Seine valley, where forests of introduced Scots pine, created on a large scale early last century, are being decimated by fungus diseases A generous mixture of hardwoods in coniferous crops is one of the best safeguards against such a calamity, and it has the further advantage of reducing the risks from fire and storms as well as of maintaining the fertility of the soil, and with it the health and vigour of the crop To summarise the position, although there are strong economic reasons for the extensive use of conifers for afforestation, there are equally strong reasons, from several points of view, for paying special attention to the cultivation of hardwood trees

When we come to consider the question of preventing the destruction of existing woodlands and trees, preserving the beauty of the countryside, and ensuring future supplies of hardwood timber, we are faced with problems of a somewhat complicated nature State afforestation may be expected to continue, possibly on a more extended scale, and it is hoped that hardwoods will receive due attention A great deal more might be done by corporations and municipalities to acquire, and even create, woodland areas within easy reach of towns , the numerous town forests in France, Germany, Austria and other Continental countries, which are so great a boon to the town-dwellers, serve as an example of what might be done in Britain It is when we consider the question of private estates that the problem presents special difficulties In some Continental countries, stringent laws exist for ensuring the proper management of private forests and the regeneration of all areas felled. There is much to be said for introducing legislation designed to ensure the regeneration of felled areas, and to improve the admittedly faulty management of so many private woodlands in Britain.

On the Continent, legislation of the kind indicated applies generally to properties with a stated minimum woodland area, and its object is primarily economic. It would not cover the case of individual or hedgerow trees, or that of the numerous small copses, belts of trees, and woodland dells which are such a feature of the English countryside. The Irish Free State, by the Forestry Act of 1928, is making serious efforts to restrict the felling of trees on private property. In Great Britain similar restrictions, however well-meaning, might prove difficult and costly to apply in practice; better results would probably be achieved, at less cost, by a policy which would give landowners more encouragement to maintain the beauty of their estates as their forbears did Something might be done by means of State aid to bodies such as the National Trust, for the acquisition of small woodland areas or park lands to be preserved primarily for æsthetic reasons Last, but not least, there is great need for educating the British public to respect trees and woodlands, which suffer from acts of vandalism unheard of in those European countries in which the 'tree sense' or 'forest conscience' is more fully developed with the help of schools, the rising generation, at any rate, might be brought up to realise that trees and woods are a heritage which should be valued and respected

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Reviews

The Concept of Time in Physics

The Serial Universe By J W Dunne. Pp 242. (London: Faber and Faber, Ltd, 1934.) 10*s* 6*d* net

IN 1927, Mr Dunne published a book recording dream experiences which seemed to indicate prevision of future events Being a thorough Copernican, he scorned the idea of personal peculiarity and began to examine the concept of time His conclusions were so strange that stronger observational evidence was generally demanded; yet it was clear even then that the theory was grounded on the general nature of thought rather than the particular data of experience The issue is now cleared In his new book, Mr Dunne applies his theory to the facts of modern physics instead of to dreams Those facts are numerous and authentic enough · we can no longer evade the challenge by demanding further evidence.

Mr. Dunne's presentation of his case deserves the highest praise The book is a model of clear thought and expression, and the style excites interest to the point of fascination without sacrifice of critical attention. A mathematical physicist might have expressed a few points differently, but that is immaterial Whatever verdict awaits the ideas, their cause could scarcely have found a better advocate.

The theory starts from the idea of a *regression*, that is, a series of terms of which each, after the first, demands the next, and which therefore extends to infinity. An artist paints a picture of the universe. But he is a part of the universe, so the picture must include a picture of himself painting the same picture—which, being the same picture, must itself include him; and so on *ad infinitum*. This is a type of all regressions. The first term (the universe) alone does not require the remainder, but when the artist in the second term enters the picture, there is no escape; we are doomed to follow the succession of artists and pictures to the bitter endlessness.

Consider, now, an objective world, A, described from the indications of independent instruments, B The instruments observe *now*, but we define the world as extended in time, and from memory and calculation represent it as a static four-dimensional thing, along the time dimension of which our instruments move from past to future The instruments, however, are not inherently independent of A, being so regarded only when they are observing it a wider view of A shows it as including B But that puts the artist into the picture The sequel is inevitable.

This process is linked with the notion of time. The world, A, extends through time, T_1, along which the instrument moves, making contact only at the 'now' But such a movement requires another time, T_2. the first—a static dimension through which A extends—cannot give meaning to the motion of B along itself When we retreat a stage and contemplate, as a single system, A with its T_1 and B moving in T_2 to observe A, a third 'time' becomes necessary Thus we regress—indefinitely

At each step the abandoned time becomes a new dimension of space—of a continuum, that is, which has as many dimensions (including the three dimensions of 'ordinary' space) as there are possibilities of independent continuous variation of the system located in it. Thus we normally imagine a three-dimensional space world changing in time. When we consider its history, we petrify its eternal progress along T_1 into an A having what is equivalent to infinite space extension in that dimension, and transfer the dynamic element of time to T_2 When we withdraw to watch B observing A, T_2 in turn is fixed, its spirit flying out along T_3 At the next step, the Gorgon's head is shown to T_3, and the vital spark escapes along T_4. Whenever T_n is time, there are $n+2$ dimensions of space—the familiar three plus the $n-1$ quiescent eternities.

We can picture the process as a mad pursuit of eternity or a relentless tracking-down of change ; in either case the effort is Sisyphean No sooner do we grasp eternity than it is transformed to infinity : we cannot arrest the passage of time in one direction without releasing it in another. The task, however, is not forced on us We can stop at any stage, provided we stop at the corresponding stage of the physical regress Thus, if we want only the ordinary three dimensions of space, we must not consider the world as extended in T_1, but merely as existing from moment to moment The contemplation of world-history commits us to a fourth space dimension and a time, T'_2

The poetry of all this is irresistible, but we are concerned with the truth Physics explores the world by arbitrarily selecting parts as instruments and giving them independent status It is thereby committed to a regressive time concept which it has not employed Anomalies are therefore found we are involved in 'imaginary' time and indeterminacy Only by accepting the fact of regression can these anomalies be removed

Before proceeding to the removal we must examine the general idea , and here caution is necessary Mr Dunne's theory—belonging, as we have said, to the world of thought—appeals to a wide public—to the philosopher, the physicist, the psychologist, the humanist and the man in the street Our point of view is that of the man of science, and we have no intention of leaving it, but we must state what it is

Science is concerned with pure thought only in the correlation of experience Our minds, however, can form far more concepts than experience needs From the scientific point of view, these additional concepts are meaningless ; they serve only for intellectual exercise

History shows that no human power has been more diligently employed than that of asking meaningless questions We do not attribute this to irony in Nature ; it appears to be a by-product of our self-chosen instrument of language "Who hath given man speech, and who hath set therein a snare ?" asked Swinburne The realm of significance is a mere patch in a boundless waste of grammatical possibility, and no scientific duty is more urgent than that of keeping within its limits.

Many philosophers will not assent to this. They (the 'nominalists' we may call them for identification, without historical or other implications) attach significance to pure thought unrelated to experience. We need not argue the matter here, for our purpose is simply to point out that Mr Dunne sits above the controversy, calmly telling the disputants the conditions they must respectively observe. The nominalist must accept the whole infinite regression : the man of science, it seems to us, is committed only to the second term—and, with a different history, might have stopped at the first Let us illustrate this by the example of time

The regression of time is interwoven with the method of describing the world by selecting parts of it as instruments The obvious conclusion is that the world should be described otherwise Science does not in principle depend on experiments we could merely watch things happen and rationalise the results For speed, of course, we adopt the experimental method, but it is a *method*, not an essential quality, and we must not attribute to the universe characteristics which belong only to our mode of describing it

This, however, is no reply to Mr Dunne To propose now to renounce the division of the world into instruments and systems observed would be quixotic The division belongs not only to our experimental procedure but even to our definitions Take, for example, such a fundamental notion as the strength of an electrostatic field This is defined in terms of the force it exerts on a unit pole But the pole changes the field, and the field changes the pole-strength Instead of expressing the observed behaviour of the whole system, we describe an exploration of a hypothetical field by a hypothetical unchanged pole The whole of physics is formed of such inventions

The only practicable course is to adapt our concepts to this procedure The structure of physics is so massive that it is much simpler to stand on our heads than to invert it, and this Mr. Dunne teaches us to do Only the nominalist, however, must make the complete overturn The physicist has merely to cock his head sideways, for one additional element of the regression will correct his imperfect start Mr Dunne is unanswerable when he claims that physics has effectively created two notions of time, but we cannot follow him in giving physical significance to others Physics does not employ a second instrument to watch the first observing the world. In retreating to contemplate such a process, therefore, we step outside the patch of significance into the waste of purely verbal relations.

Using two time dimensions, Mr Dunne gives an attractive derivation of the world of special relativity. Here time has become space ; that is, it has shed its 'becoming' character and assumed infinite extension. But our clock measures becoming ; we cannot put it when we like in time as we can put a metre-stick where we like in space—it ticks only when it is. Before using it as a scale for petrified time, therefore, we must multiply its readings first by i to rotate them through 90° to the T_1 axis ; and secondly by a factor c to convert the unit of vital time into that of dead time, or space This factor Mr. Dunne calls "the velocity of the now" ; that is, the rate at which the instrument, which touches the world A only at the now, travels along the T_1 dimension of that world. Distance along T_1 in space units is thus icT_2, or simply icT, since T_2 is measured as time.

This sounds fantastic, but it is rigidly logical "The velocity of the now" is no more fanciful than the familiar idea that for a man travelling with light, time stands still ; he is a travelling 'now' The significance of this natural 'velocity', dT_1/dT_2, however, is obscured when c is regarded as the velocity of light, for that is dS/dT also , but it becomes extremely suggestive when we consider the ratio of the electromagnetic and electrostatic units That ratio also is c, and issues from experiments in which it cannot be interpreted as dS/dT without introducing *ad hoc* conceptions We get a new view of the matter when we consider that in the two systems of units we are implicitly defining time in its moving and static aspects

Scarcely less illuminating is Mr Dunne's discussion of the principle of uncertainty He shows that this arises from the division of the world into instruments and observed systems, and that we can make the uncertainty regress with the instruments, leaving a determinate world behind The fact that this principle had nothing to do with Nature we had discerned before, but Mr. Dunne's treatment puts it in the clearest possible light.

We are less impressed by Mr Dunne's interpretation of the quantum of action, which perhaps we have not fully understood, nor do we take kindly to his more general philosophy. Taking force, space and time as elementary indefinables, he works out a scheme of dimensions for each term of his regressive observer, and gives a refutation of subjective idealism in which we feel he has been anticipated by Samuel Johnson His aim is to reconcile physics and psychology, and the effort is very ingenious We doubt, however, if a union of the most with the least developed of sciences is yet possible, and we think that in attempting it Mr Dunne is sacrificing the substance of his idea for the shadow. If force is elementary the passage to general relativity is closed, for that does not recognise force. There is fascination, at least, in describing the physical world in purely temporal terms, putting icT for space and $(ic)^2 T$ for mass, in relativity fashion ; and Mr. Dunne's picture of *ic* as an operator which rotates one dimension of time into the next presents an imaginative aspect of the process which we feel is badly exchanged for a questionable psychological interpretation.

We are unable also to accept Mr. Dunne's assurance of immortality It seems to us that on a priori grounds this question can be answered only by experience, and when pure reason offers an answer we can only look for the fallacy Mr. Dunne argues that the destruction of observer 1, moving along T_1, cannot affect observer 2 moving along T_2, and therefore, since there is no reason why observer 2 should die, he goes on observing In familiar language, bodily death does not prove cessation of consciousness We agree , but neither does it prove continuance of consciousness There is no reason, apart from experience, why observer 1 should cease in T_1 , we simply find that he does Similarly it seems to us that observer 2 might (or might not) cease in T_2 , we must wait and see.

Mr Dunne's book contains so much of real value, however, that only with great reluctance do we record what we believe to be its weaknesses That a man untrained in theoretical physics should have penetrated the jungle of relativity and quantum theory and reached the central clearing is an event of such magnitude as to make ridiculous any preoccupation with the scratches received on the way Mr Dunne's achievement is a great one, and we hope it will receive the recognition it deserves HERBERT DINGLE.

Sex and Culture

Sex and Culture By Dr J D Unwin Pp. xxiv + 676 (London Oxford University Press, 1934) 36s net.

THE principal thesis of this highly elaborate investigation is that there is a causal relationship between sexual opportunity and cultural condition Sexual opportunity is measured by the kind and amount of regulation that societies employ for controlling or checking the sex impulses before and after marriage Cultural condition is used in a very narrow sense to stand for the manner in which a people conceives of the power or powers in the universe, as judged by the outwardly observable steps that are taken to maintain right relations with it or them.

Dr Unwin distinguishes three types of cultural condition the deistic, which applies to peoples who carry out their rites in temples, through the agency of priests , the manistic, which refers to peoples who pay post-funeral attention to the dead , and the zoistic, or peoples who do neither of these things. The transition from the zoistic to the deistic cultural condition indicates, according to Dr Unwin, a growth of thought, reflection and energy Sexual opportunity is determined principally by asking whether or not a people condemns pre-nuptial unchastity. Dr. Unwin claims that an inductive survey of eighty uncivilised peoples (forty-seven zoistic, twenty-one manistic and ten deistic, two uncertain) establishes a definite relation between degree of sexual continence and cultural condition. The data show, he thinks, that all the peoples who allow pre-nuptial sexual freedom are in the zoistic cultural condition; that all the peoples who impose occasional or irregular continence are in the manistic phase; that pre-nuptial chastity is accompanied by the deistic cultural condition, and that in each class of cases the converse propositions may also be shown to be true He concludes that cultural condition and sexual opportunity are not only definitely associated in the manner indicated, but also that the relation is a causal one, the reduction of sexual opportunity providing the energy required for cultural change The transition from association to causal connexion is effected by an appeal to psycho-analysis, which has independently arrived at the conclusion that civilisation or culture has depended upon a restriction or repression of the sexual impulses and a diversion of libidinal energy

Dr Unwin has handled his material with great skill, and his induction may possibly be true Nevertheless, the methods which he has employed seem open to serious objections First, to judge social energy by reference solely to the way in which a people behaves to the mysterious powers in the universe seems arbitrary procedure, when no account is taken of their arts and crafts, their power of organisation, their skill in war, in trade or generally in the control of natural forces Even in the magico-religious field proper, the criteria employed are of doubtful adequacy Secondly, difficulties arise from the relatively small number of cases utilised in the survey No doubt Dr. Unwin was hampered by the poverty and vagueness of the anthropological material He asserts that, so far as his knowledge goes, the behaviour of the societies that he has omitted from consideration does not militate against his induction But in a matter so controversial and in the absence of corroborative evidence from other fields of social energy, his induction rests on a precarious basis and might be shaken by a broader survey This applies especially to his deistic societies, of which Dr. Unwin enumerates only ten cases, particularly as the evidence regarding pre-nuptial relations is doubtful regarding three or four of them. Thirdly, the method that Dr Unwin employs is that which a logician would describe as that of agreement and difference The validity of conclusions so drawn depends upon the elimination of alternative causes But this Dr. Unwin makes no attempt to do. He does not inquire, for example, whether the prohibition of pre-nuptial relations is correlated with the prevalence of marriage by purchase or other features of the family structure, or again, with the general development of law in other spheres of behaviour.

Finally, Dr. Unwin's conclusions may to some extent be checked by reference to an inquiry conducted on different lines by the late Prof. Hobhouse, Mr G. C Wheeler and the present writer in 1915 ("The Material Culture and Social Institutions of the Simpler Peoples") There the attempt was made to correlate regard for chastity with cultural grade as measured by economic criteria, the peoples being classified into lower and higher hunters, two grades of pastorals and three agriculturals In the matter of pre-nuptial unchastity, we found no constant tendency, though the cases of condemnation were more numerous among the agricultural and pastoral peoples than among the hunters If other points relating to chastity are considered, such as the punishment of adultery and the prevalence of wife-lending, we found that, on the whole, there was an increasing tendency for the family life to be consolidated with advance in economic grading Owing to the vagueness of the evidence, however, we should hesitate to assert universal association between sexual regulation and economic conditions, still more any causal connexion. It may be added that Prof Westermarck, who has made a very wide survey of the evidence, concludes that there is no relation between the toleration of unchastity and the degree of culture, and that, on the contrary, chastity is more respected in the lowest tribes than in the higher ones

Upon the whole, my impression is that the evidence available in the present state of anthropology is neither detailed nor abundant enough to afford a satisfactory basis for a generalisation so far-reaching as that propounded by Dr. Unwin.

MORRIS GINSBERG.

Mineral Resources of the French Colonies

Publications du Bureau d'études géologiques et Minières coloniales. *Introduction aux Études Minières coloniales* Pp viii + 349 + 9 plates. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1934) 36 francs.

THIS volume follows up and forms part of a useful series of publications issued during the last two years or so by the Bureau d'Études géologiques et Minières coloniales on the subject of the mineral resources of the French Colonies. Its object is to give an account of some general aspects of the mining industry with which it is important that colonial miners and geologists should be familiar.

An opening chapter on the genesis of minerals is followed by one on laterite. These are followed by chapters on alluvial deposits, geophysical prospecting, health, transport, native labour, microscopical studies of coal and metallic ores, commercial problems and the relation of France to its colonies with regard to the supply of metals

A consideration of these pages shows that France and her colonies are far from self-sufficient in their supplies of metals The apportionments of mineral resources among the nations of the world are singularly irregular. France has ample home supplies of iron, and therefore has no need at present for her large colonial output in north Africa, which goes largely to Great Britain and Germany We are reminded, however, that a half a century from now—a short time in the history of a nation—a state of impoverishment in the supplies of iron ore from the eastern basin of France may begin to assert itself, and France may then need her colonial output of iron ore.

New Caledonia produces supplies of nickel matte amply sufficient for the needs of France, but it is curious to note that a large part of the output of this matte is sent to Great Britain, the United States and Belgium, and from these countries, none of which produces nickel ore, France has to import for her own needs considerable amounts of metallic nickel that has been made in part from New Caledonian matte.

The case of chrome ore is also interesting, for New Caledonia produces ample supplies of high-grade chrome ore, the production of which is controlled by foreign capital Only a small proportion of the output goes to France, whose further requirements have to be met by importing large amounts of chrome ore and ferro-chrome from foreign countries

Among other mineral supplies necessary for the metal industries, the French colonies have considerable resources of lead ore, zinc ore and graphite, but, so far as yet known, very little of the ores of manganese, copper and tin On the whole, the position as regards the output of metalliferous ores in France and her colonies compares quite unfavourably with the position in the British Empire

The eminent specialists who have contributed to different sections of the book include such well-known authorities as L de Launay, A Lacroix and A Lambert-Ribot The book is well indexed and illustrated, and makes a useful addition to the serviceable memoirs already issued by this very active Bureau.

Short Notices

Man versus Rabbit. By A. H B Kirkman (ULAWS Monographs, No 4b) Second edition, entirely rewritten Pp vi+74+9 plates (London: University of London Animal Welfare Society, 1934) 1*s.*

ONLY those who live in the country can properly appreciate the damage done by rabbits, where they are at all numerous. As all gardeners know, the losses they inflict in the course of the year are both serious and exasperating; and farmers, in many parts of the country, suffer even more severely. Mr Kirkman, then, has done us great service by presenting in this small volume an able and impartial summary of the methods of 'farming' rabbits for the market, on one hand, and their destruction as 'vermin' on the other From whichever of these two aspects they are regarded, the manner of their slaughter is an issue of the first importance, which forms the main theme of Mr. Kirkman's book. Its aim is to secure legislation to prohibit the use of steel-traps He has shown how ineffective they are for their avowed purpose of reducing the rabbit-pest, as well as the harm they do—apart from the cruelty which attends their use—in killing or maiming other animals more or less directly useful to man

With praiseworthy fairness Mr. Kirkman has cited the views of those who are still in favour of the use of the steel trap. But against them he arrays overwhelming evidence of landowners, game-keepers, farmers and gardeners who deplore their use, employing instead ferrets, nets or gas, according to circumstances. Some may object even to these measures But we must not let 'humanitarianism' become an obsession. For there can be no doubt that these animals are a grave menace to both gardener and farmer There are comparatively few of those whose crops are now so seriously menaced, or among sheep farmers, who would not welcome an Act of Parliament forbidding the use of steel-traps for any purpose whatever

Evidence is given by Mr Kirkman to show that, as a means of reducing the rabbit-pest, steel traps are worse than useless, for they kill vastly more bucks than does The reason for this differentiation is unknown, but it is suggested that the does wander less and are more timid and suspicious This is only one of many surprises that have come to light in the course of Mr Kirkman's investigations

We are glad to find that the author directs attention to the folly of an intensive war on stoats Besides their help in keeping down rabbits, they are extremely valuable allies in the war that, so far, is only half-heartedly carried on against rats. while the weasel as a mouse-destroyer is no less valuable

The Design and Construction of High Pressure Chemical Plant. By Harold Tongue. Pp ix+420+69 plates (London: Chapman and Hall, Ltd, 1934.) 30*s.* net.

ONE of the pioneer laboratories to study the application of high pressures in chemistry and chemical industry has been the Chemical Research Laboratory at

Teddington directed by Prof G T Morgan; there the author gained his experience and carried out pioneer work A pleasing feature of the work at Teddington has been the facility afforded to members of industrial firms to gain experience in the design and construction of high-pressure plant Their needs have given the author a clue as to those aspects of his subject in which information is of the greatest practical value

The book is essentially a chemical engineering treatise, and is therefore fully illustrated with pictures of actual plant and diagrammatic and detailed drawings The author has sought to collect together all the information pertinent to the subject Thus he deals with gas compressors, with the preparation, purification and cost of the industrial gases; with the design of pressure vessels, with the measurement of pressure, with valves, fittings and pipes.

High pressures, together with high temperatures, have set a number of new problems for the metallurgist, the creep of steel, embrittlement and the penetration by hydrogen have been new factors for study, and many unexpected difficulties have developed in the manufacture of large pressure vessels for high-pressure service Ammonia, methanol, the hydrogenation of fatty oils, of coal oils and of petroleum, are still the large scale pressure processes In addition, there is the high pressure oil cracking industry An ever increasing number of other products are being manufactured in high-pressure catalytic circulatory plants

There is a definite need for this book, which will be found to contain a good deal of information now published for the first time

The Ideas of Physical Chemistry By H McKay and H A C. McKay Pp x+301+8 plates. (London William Heinemann, Ltd, 1934) 7*s* 6*d*. net

This volume, published without preface, but dedicated to the authors' mother and grandmother, appears from the wrapper to have been written for the "layman" or "non-chemical specialist" It is there referred to as an introduction, in which the facts of physical chemistry are described in simple language which anyone can understand A perusal of the text gives the impression that the authors have attended a recent course of up-to-date lectures on physical chemistry, in connexion with which some modern textbooks were recommended for supplementary reading, and that they have then written up their lecture notes in twenty-seven chapters, in the optimistic expectation that lay readers will possess the same grounding in chemistry and physics as the authors had when they began the course, and will therefore be able to follow their summaries of the subjects thus selected. The impression that the authors are relying on second-hand information, and have not gone back to original sources for the material used in constructing the book, is also suggested by the diagrams which illustrate the text, since these are almost all 'blackboard sketches' On the other hand, seven plates, mainly of spectra, are admirably reproduced

The subjects dealt with are not easy to expound or to understand, and it is doubtful whether the lay reader will be able to follow with advantage a narrative in which so much is taken for granted; on the other hand, the serious student ought at least to select for supplementary reading books which are based upon first-hand contact with original sources; but there is perhaps an intermediate grade of readers to whom the present compilation will be useful, and the publishers have done their share in making the book attractive to them.

The Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland: with a Record of Publications issued during Session 1933–1934 Compiled from Official Sources: Fifty-first Annual issue Pp vii+164. (London. Charles Griffin and Co, Ltd, 1934) 10*s* net

The fifty-first annual issue of this well-known Yearbook is likely to be as invaluable as its predecessors. All the particulars are compiled from official sources, and therefore reliable Government departments as well as learned societies are represented, and information is given concerning address, membership, meetings and publications To facilitate reference, the societies are classified by subject into fourteen sections, and a good index is appended

It is gratifying to note that this reference book is receiving increased support The publishers deserve this encouragement, for the volume is well produced, and is full of useful information It should be on the shelves of all libraries, institutions, laboratories, etc, which are interested in any branch of science

Popular Handbook of Indian Birds By Hugh Whistler Second edition Pp. xxviii+513+20 plates (London and Edinburgh Gurney and Jackson, 1935.) 15*s* net.

A **review** of the first edition of this useful handbook to the birds of India was published in **Nature** of October 6, 1928, p. 533. The book is very good value for its price, which perhaps explains why the first edition was so quickly exhausted In that edition, 250 common Indian birds were described; in the second edition, 275 are described at length A new feature is the brief mention with short descriptions of a further 230 species The requisite number of extra illustrations have been added The whole text has been revised and brought up to date

Facts and Theories of Psychoanalysis By Dr Ives Hendrick Pp xi+308+xii (London Kegan Paul and Co, Ltd, 1934) 10*s* 6*d*. net

Dr Ives Hendrick gives here what is probably the best account of the present position of this art—psychoanalysis can scarcely be said to have reached the position of a science yet The book is divided into four parts dealing with the facts, theories, therapy and present status of psychoanalysis. The author is largely a Freudian, and so does not approve of the theories of Adler, although to many in Great Britain the latter are more acceptable; but then the theories are not psychoanalysis as it ought to be understood as referring purely to Freudian theory.

Television in Great Britain*

THE report of the Television Committee under the chairmanship of Lord Selsdon, issued last week, seems to have taken the public and most of the experts by surprise, probably due to the fact that during the last nine months, when the Committee was sitting, they had heard practically nothing about television, and the low definition broadcasts that were given did not seem to be of much permanent value In particular, they find it difficult to believe the following extract from the report. "The time may come when a 'sound' broadcasting service entirely unaccompanied by television will be almost as rare as the silent cinema film is to-day," although the Committee modifies this slightly by saying that, in general, sound will always be the most important factor in broadcasting The promotion of television, therefore, will not hinder the continual development of sound broadcasting

Recent advances have contributed largely to the development of a technique whereby the scene to be televised is first photographed on ordinary cinematograph film It is then developed and scanned by light transmitted through it, and this system is used to provide a method of 'delayed' television when direct scanning by a mechanical device would be difficult or impossible Equipment is now available in which the cine-camera is connected with the film scanner The film after exposure is fixed, washed and partially dried It then passes through the scanner, and after further drying is stored for future use if required In this way, the new methods of producing rapid and sensitive emulsions for photographic processes have overcome the difficulties due to the comparatively feeble sensitivity of photo-electric cells

The direct scanning of open-air scenes and studio subjects is now possible without using abnormally powerful illuminating devices This is done by cathode rays in combination either with minute photo-electric cells or photo-sensitive surfaces One such device is being developed in the United States, Germany and Great Britain. The image to be televised is focused by means of lenses on to a photo-electric mosaic contained in a cathode ray tube. The cathode ray beam is directed on the surface of the mosaic, and by a method of magnetic control the image is scanned repeatedly. Electrical energy is thus drawn off from the photo-electric mosaic by the cathode ray which is proportional to the light intensity of the picture, and can be transmitted to operate the distant television receiver. The Committee definitely states that satisfactory reproduction of outdoor moving scenes can now be attained by this method when the visibility conditions approximate to those under which satisfactory cinematograph pictures can be taken It is assumed that the recording apparatus can be located reasonably close to, and at a moderately constant distance from, the scene which is being televised It is stated that, even in this stage of development, satisfactory reproduction can be obtained of such scenes as a procession, a lawn-tennis match and the finish of a horse race The transmission of the view of the whole course of a race or similar event would doubtless present much greater difficulty

On the day following the publication of the report, Baird Television Ltd gave the first public demonstration of the system as it will be used in the home when the new ultra-short-wave transmission by the B B C begins next autumn The demonstration was given in Victoria Street, and the Baird transmitters were at the Crystal Palace, a distance of about 10 miles, the wave-lengths used being 7 metres for vision, and 8 5 metres for sound Two receivers were shown, the sizes of the screens being 12 in × 9 in and 8 in × 6 in respectively There were about fifty people present and they could see both screens, sometimes the room was darkened, but at other times it was illuminated by ordinary light, the difference in the visibility of the pictures in the two cases being slight

The larger of the two receivers had to be adjusted several times during the performance, but the smaller one was not touched We first saw a 'close-up' of the announcer It was quite a good picture and easily recognisable—quite as good as the pictures seen in the poorer cinemas He said that the demonstration was to prove that the television of pictures of high definition over a large area is a practical reality, and that the reception of such programmes in any part of the Greater London area is possible by a Baird receiver This area has a population of more than ten million people He contradicted the assertions recently made that with ultra-short wave-lengths (4–8 metres) the maximum range is 5 miles With the present arrangements, satisfactory results are obtained up to 30 miles from the transmitter The interference trouble, sometimes produced by motor-vehicles, has been successfully overcome There was no trace of it in the pictures shown in the offices in Victoria Street on a busy afternoon.

The second item in the programme was given by Miss Alma Taylor from the Crystal Palace. She showed some new fashions in hats and various styles of hairdressing. She also, by means of a telephone, entered into an animated conversation with a member of the audience This was real television; we saw and heard two people talking together at a distance of ten miles. We next saw an out-of-doors horse-jumping and racing competition taking place on the terrace of the Crystal Palace A boxing match was then shown in one of the studios at the Crystal Palace with the attendant crowd and the noise and cheers These two were done by 'delayed' television A proof was given that the interval between the occurrences and seeing them on the screen was 35 seconds Excerpts were also given from several of the well-known Gaumont-British films including "I was a Spy" and "Jack Ahoy" The singing and the sounds of the dancing were reproduced excellently and the flickering was scarcely noticeable although a picture frequency of only 25 pictures per second was used A complete "Mickey Mouse" film was shown and was almost as good as those shown in the cinemas.

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* Report of the Television Committee. (Cmd. 4793.) Pp. 27. (London. H.M. Stationery Office, 1935.) 6d. net.

After seeing this demonstration, we agree with the Committee that there is good entertainment value in high-definition television accompanied by sound We also agree that in general the sound is the more important factor in broadcasting

Owing to the close relationship which must exist between sound and television broadcasting, the B B C is obviously admirably suited to be the operating authority The following advisory committee has been appointed to advise the Postmaster-General on points arising in connexion with television and to exercise control over the actual operation of the service Lord Selsdon (chairman), Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, who will be chairman of a technical sub-committee, Col A S Angwin, assistant engineer-in-chief of the Post Office; Mr N. Ashbridge, chief engineer of the B B C, Vice-Admiral Sir Charles Carpendale, controller of the B B C; Mr F. W Phillips, assistant secretary of the Post Office

The transmission of high-definition television is practicable only with ultra-short waves, for a wide band of frequencies is required. Fortunately, there is no difficulty at present in allocating suitable wave-lengths—between 3 and 10 metres—for public television in Great Britain Technically, it is desirable that the transmitting stations should be situated at elevated points The mast at present in use in Berlin is 430 ft high, and the question of employing masts of greater height is being discussed in Germany The Crystal Palace site of the Baird Television Company was chosen because it is the highest point in London The top of the south tower of the Crystal Palace is 680 ft. above sea-level, and the Baird aerials on the top of the tower give the maximum possible range of any site in the Greater London area The premises taken over by the Company cover an area of 40,000 sq. ft and are all on one open ground floor

The Committee has come to the conclusion that a start can best be made with a service of high-definition television in London It points out that there are two systems of high-definition television which are in a relatively advanced stage of development One of these is owned by Baird Television Ltd and the other by Marconi—E M I (Electric and Musical Industries) Television Co, Ltd The Committee suggests that an extended trial of these two systems be made under strictly comparable conditions They will be installed side by side in a London station and will issue programmes alternately and not simultaneously Among the conditions imposed are that the price demanded must be considered reasonable by the advisory committee and that the B B C be indemnified against any claim for infringement of patents The definition also should not be inferior to a standard of 240 lines for scanning and 25 pictures per second The present experimental transmission gives 30 lines per picture and 12½ pictures per second The pictures are 'coarse' in texture, and the flickering is objectionable

The Committee looks forward to the time when there will be a general television service throughout Great Britain Television broadcasts will be relayed by land line or by radio to substations in various parts of the country Owners of sound receiving sets will be glad to hear that, during the first experimental period at least, the cost of the new transmission will be borne by the revenue from the existing 10s license fee Afterwards a reasonable share will have to be contributed by the Treasury and the Corporation

The smaller of the complete sound and vision receiving sets made by the Baird Television Company is a cabinet 4 ft high, 2 ft wide and 2 ft. deep. The size of the picture is 8 in. × 6 in, and it is sufficiently brilliant to be seen quite clearly with ordinary room lighting It can be used with any type of high-definition transmission having 100–500 lines and 12–50 pictures per second. It can be seen by ten people in a room quite comfortably. It requires little skill to operate. The selling price will be at first about £50, but when bulk production has been started it is likely to be reduced considerably As it is operated on ultra-short wave-lengths, there is no trouble with atmospheres The Company also produces a larger set suitable for an audience of thirty people and having a screen 12 in × 9 in. These sets are not likely to become obsolete by changes in transmission technique during the next four years The price will be at first about £80.

Social and Industrial Aspects of Scientific Research*

IT is difficult to imagine a document which better illustrates alike those social aspects of scientific research to which attention has been repeatedly directed in recent months, at the British Association meetings or elsewhere, and the way in which the direction of scientific research is itself determined by the needs of the community, than the nineteenth annual report of the Department of Scientific and Industrial Research which was issued on February 2 This report covers the period October 1, 1933, to September 30, 1934, and contains the brief report of the Privy Council Committee, signed by Mr Stanley Baldwin, the longer report of the Advisory Council over Lord Rutherford's signature, and summaries of the work of the National Physical Laboratory, the Chemical Research Laboratory, the various research associations and research boards Certain of the latter issue their own independent reports, but no one document issued by the Department gives such a comprehensive and lucid account of the way in which the Department of Scientific and Industrial Research serves our national life, whether in departments of State, industry or the social needs of a civilised community

The expenditure of the Department during the year ending March 31, 1934, was £664,482 gross, or £476,897 net, as compared with £451,987 net in 1932–33 Receipts decreased, however, from £202,749 in 1932–33 to £187,585 This latter sum includes £59,774 in fees for paid work for industry , £10,209 representing contributions from industry for co-operative research , and £99,705 from other Government funds, including a payment of £21,520 from the Road Fund for building and road research and a grant-in-aid of £30,000 from the Empire Marketing Board for food investigation. Net expenditure on the National Physical Laboratory was £118,687 , on the Chemical Research Laboratory, £22,164 ; building and road research, £29,684 , food investigation, £10,707 , forest products research, £33,911 , fuel research, £80,423 , and water pollution research, £5,453 The Geological Survey and Museum received £63,426 and research associations a total of £58,992

Particular stress is laid in the report of the Advisory Council upon the efforts made to improve the position of the research associations, as regards both obtaining greater financial support from industry and also securing the greater financial stability which is essential if long-range researches are to be undertaken and reasonable prospects of a career offered to the scientific staff. This appeal for further support from industry is not, however, based solely on the prospects of future benefits. It rests equally on the results already achieved, and stress is once more laid on these other ways in which science can assist industry by the application of existing knowledge and by the extension of the scientific method and outlook

An encouraging sign of the growth of this spirit in industry is seen in the expansion of those researches undertaken by the Department with the financial co-operation of industry As an example of such arrangements during the year may be mentioned the research on such questions as the effect of waves on resistance and pitching of ships and their propulsion, the effect of wind resistance, the behaviour of rudders and the improvement of propellers, which are carried out in the William Froude laboratory of the National Physical Laboratory This work, which is of fundamental importance in the design of new ships, is financed as to one half by industrial subscriptions

Other examples of such co-operative research are found in the investigations, also at the National Physical Laboratory, bearing on the practical development of steels for use at high temperatures, as in the turbine or in chemical engineering, investigations at the Building Research Station covering the safety factors of steel-work, the discovery of British sources of materials for increasing the resistance of concretes and mortars to chemical attack, the effect of sea-water on concrete, problems of driving concrete piles, welding in steel structures, and the continuous study of heating and ventilating problems throughout the year in a 'controlled weather' house which is now being erected through the financial co-operation of industry secured through the Institution of Heating and Ventilating Engineers.

The bearing of this co-operative work at the Building Research Station on the housing question needs no emphasis It is, however, worth noting that the introduction of new materials and the displacement of obsolete regulations offer most hopeful lines of radical development in the building industry, and both alike depend on the continuous application of scientific research. The survey, conducted by the Building Research Station and the Fire Offices Committee of the fire insurance offices, of the problems of testing building materials for their resistance to fire, is overcoming difficulties in the way of provision for fire-testing stations where large-scale experiments can be conducted.

Building research in fact figures prominently in the report. Proposals made by the Advisory Council are concerned with an expansion of the activities of the Station whereby the results of research and investigation would become available at an earlier date and also with the special problems involved in the construction of flats These include investigations on fire risks designed to test whether regulations in Great Britain are too restrictive or not, and others relating to the transmission of sound through the structural elements or through floors and partitions.

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* Department of Scientific and Industrial Research Report for the Year 1933–34 (Cmd 4787) Pp. iv+192 (London H M. Stationery Office, 1935.) 3s. net.

From housing questions it is an easy transition to problems bearing on food supply, and here the work of the Department affords a striking example of scientific co-operation with the Dominions overseas Even the brief summary contained in the Advisory Council's report indicates our immense debt in this field to Sir William Hardy, and the work of the Food Investigation Board is steadily growing in importance At the Covent Garden laboratory there is a full-time officer, experienced in the examination of experimental consignments of fruit and vegetables sent to Great Britain, whose services are also available for Dominion and Colonial Governments A definite advance has been recorded during the year in the application of gas-storage to shipments of chilled beef from Australia and New Zealand and a modified method of stowage has been developed which promises to be more effective and economical

Investigations in this field range over almost every type of foodstuff A storage atmosphere has been worked out, for example, in which the characteristic flavour of Cox's Orange Pippin apples can be retained during six months' storage Experiments at a Wiltshire factory have shown that rapidly growing pigs are more suitable for bacon production than slowly growing pigs With lighter salting supplemented by cold storage, a method of cure has been evolved which produces salted herrings more delicate in flavour and more suited to the modern palate than those previously available Problems of the herring industry have also been considered, and the discovery that herrings, frozen in brine at − 20° C, make good kippers after four months' storage at that temperature, which is now being tested on a semi-commercial scale, may enable supplies to be carried over from periods of glut to the times of shortage experienced particularly in winter

Besides the Food Investigation Board, several of the research associations are concerned with investigations on foodstuffs The Research Association of British Flour Millers is studying the reasons for one flour giving better bread and dough than another, and developing methods of measuring the physical properties of dough The Research Association for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades has indicated methods for preventing boiled sweets being reduced to a sticky mass by the absorption of moisture and has also suggested modifications in the composition of such sweets to prevent coalescence under the influence of heat.

Turning from food to clothing, we are still within the field in which the activities of the Department touch the home The British Boot, Shoe and Allied Trades Research Association has done much to improve footwear service by providing knowledge which makes shoes more hygienic and comfortable, while the Leather Manufacturers Research Association has given a good deal of attention to the prevention of mould growth on leather The Wool Industries Research Association's new process for unshrinkable wool, yarns and fabrics is being exploited under mill conditions, and materials should be available for the public early in this year New motor fabrics from wool and rubber latex are also being introduced to the public The Linen Industry Research Association has investigated the behaviour of linen under repeated launderings, and other research in this field is undertaken by the Launderers' Research Association

Leaving the home we come naturally to transport, where the Road Research Station is responsible for fundamental work on road construction, which has a vital bearing on safety on the roads, skidding problems and lighting problems are both being investigated.

Space permits not even the briefest reference to many other ways in which the work of the Department of Scientific and Industrial Research is affecting almost all our public services—power, water, lighting, gas, fuel—and steadily raising their efficiency Mention should, however, be made of the work of the Forest Products Research Laboratory on Empire timbers, of investigations on the detection of toxic gases and the production of cheap and efficient respirators for use in industries where dust is a menace to health, investigations on cylinder wear of internal combustion engines—probably the most important cause of deterioration in the engines of motor-cars—radio research on the propagation of waves and long-distance transmission, dental investigations, illumination research, investigations on lubricants and on atmospheric pollution, if only to illustrate the immense range of activities of this one Department. Nor should it be forgotten that, in the various institutions aided by the Department, new instruments and methods are continuously being developed by which the control of existing processes or the solution of urgent problems is being achieved The interpretation and exposition of the record of work contained within the covers of this report is a task to which every scientific worker might well address himself.

Obituary

DR. F. A. DIXEY, F.R.S.

FREDERICK AUGUSTUS DIXEY commenced his scientific career as a medical man and took the degree of B.M., B.Ch., Oxon, in 1884, followed by the D.M. in 1891. He was for a while demonstrator in physiology at University College, London, and also at Oxford from 1883; and a histological preparation made by him was used for an illustration still reproduced in Quain's "Anatomy". But it was as an entomologist that Dixey will be remembered: his first entomological publication was on the phylogenetic significance of wing markings in certain Nymphalid butterflies, and until his death on January 16, in his eightieth year, he was associated with the study of evolutionary entomology at Oxford, so intimately bound up with the name of Poulton.

Dixey was a true Darwinian and supporter of the current theory of mimicry as produced by natural selection. He especially studied the Pierinæ, or 'white' butterflies, on which he became an acknowledged expert, and made two subjects particularly his own. Fritz Muller in 1878 had shown that two distasteful species might benefit by resembling each other: "they may even have gone to meet each other" he wrote; but Müller did not develop this theory. Dixey approached the subject independently through practical study of specimens and, in an important contribution on the phylogeny of the Pierinæ following on the lines of his first paper, he introduced in 1894 the term 'reciprocal mimicry' to express the production of a superficial likeness between distasteful forms of widely removed affinities by the apparent interchange of characters peculiar to each. This term was superseded by 'diaposematism' to bring it into conformity with others used by Poulton. The theory of Muller and its important extension by Dixey were controverted by G. A. K. Marshall on statistical grounds; but R. A. Fisher in 1930 stated that Marshall's arguments were untenable.

"The Relation of Mimetic Patterns to the Original Form", followed by "Mimetic Attraction" (1896-97) showed the successive steps through which a complicated mimetic pattern could be evolved in simple and easy stages from a form presenting merely the ordinary aspect of its own genus, and that the process of gradual assimilation, starting from one given point, may take several divergent paths at the same time. In other words, the members of a single group may assume several different mimetic developments, each one corresponding to a distinct model, but all derived by easy stages from the same original form.

A characteristic of natural selection is the production of one effect by different means, and in a study of mimetic butterflies of New Guinea, Dixey showed how a certain type of coloration was produced by spot and stripe markings the position of which, different in absolute detail, resulted in a uniform appearance relatively to the whole exposed surface of the wings.

Dixey was convinced of the importance of studying geographical distribution in its relation to mimicry, and made this the subject of his presidential address to Section D (Zoology) of the British Association in 1919. Coincidence, sometimes invoked to explain mimicry, can produce resemblance, and, in the guise of *advocatus diaboli*, he demonstrated examples from different parts of the world bearing similar patterns. But such resemblances are crude, and lack the perfection of detail of typical mimicry, and thus coincidence fails to explain the latter.

Seasonal forms of butterflies and the possible direct influence of climate were the subject of Dixey's second address, on "Entomology and Evolution", to the Entomological Society (now Royal) of which he was president in 1909–10. He maintained that the Lamarckian interpretation of the effect of climatic conditions was not justified: "the modification is not inherited from the soma of the parent but is consequent upon the direct action of this external influence upon that parent's germ plasm".

Dixey's other favourite subject, in which he will long be recognised as a master, was the study, in Pierinæ, of specialised scent-producing scales to which Fritz Muller had directed attention in 1877–78. He found in 1899 that the peculiar scent of a male 'green-veined white' (*napi*), which had long been known to exist, could be detected on a brush used for removing scales from the wing, and in 1904 wrote that the scent of male butterflies is associated with specialised scales, confined to that sex, which can be removed from the wing and their odour perceived. Such scales are confined to the upper surface of the wing, and may be aggregated to form scent-producing organs supplied with air by special tracheæ. These studies culminated in a memoir (1932) containing 437 drawings of scent-scales in different species of Pierinæ.

At the time of his death Dixey had commenced the final copy of a paper on specialised scales on a portion of the wing of an American Pierine which, it is hoped, may be published as a posthumous contribution. The investigation of special scent-producing structures, carried on by Dixey, has been splendidly developed along different lines, following Fritz Muller's suggestion of 1877, by H. Eltringham. Elaborate apparatus on both wings and abdomen of male Danaine butterflies have been minutely described, and their use in the field has been witnessed by more than one observer. Further developments have resulted in the discovery of an intricate scent-producing apparatus on the head of a minute 'caddis-fly', and specialised glands, the function of which is unknown, are being discovered on many different parts of the body in insects of diverse kinds.

Dixey returned to histology in 1931, and published an account of the development of wings in Lepidoptera.

Dixey was elected a fellow of the Royal Society in 1910, and was vice-chairman of the Association of British Zoologists: he was a familiar figure at meetings of the British Association, and played a genial part in the social gatherings.

G. D. HALE CARPENTER.

SIR WILLIAM SLINGO

THE death on January 19, at the age of seventy-nine years, of Sir William Slingo marks the passing of a distinguished civil servant and engineer, whose career has been associated with wide and far-reaching developments in the art of communication.

At the age of fifteen years, Slingo entered the Post Office as a telegraphist, and twenty-eight years later was appointed to the Engineering Department, from which he eventually retired as engineer-in-chief in 1919 after a career in the civil service of nearly fifty years. During that period, which covered the growth of the trunk telephone system, the transfer of the National Telephone Company's plant to the State and the subsequent developments of telephony in Great Britain, Sir William Slingo played a very active part. He was primarily responsible for the compilation of an inventory of the National Telephone Company's plant on its acquisition by the State. On the basis of this inventory, an award of 12½ million pounds sterling was made to the Company instead of the twenty one millions claimed.

Although at the outset Slingo was a telegraph engineer, at an early stage he proceeded to widen his outlook on telephone problems, and made substantial contributions to other branches of electrical engineering. He was responsible for the design and installation of one of the earliest electrical lighting plants in London, when he acted as consulting engineer to the Drapers Company for an installation at the East London People's Palace.

To Sir William Slingo's credit must be placed the achievement of building up the nucleus of an engineering staff from a group of telegraphists whose previous training was mainly that of manipulative skill. In doing this, he first made himself proficient in the art, and then for many years carried on single-handed the pioneer work of training the telegraph engineers of the future. He founded on his own initiative at the General Post Office, the Telegraphists School of Science, beginning with a handful of students, which had grown to 850 when he relinquished the post of principal. Many engineers of established reputation in the art of tele communications received their earliest training in that school. Sir William Slingo's work during this period in furthering the study of telegraph and telephone engineering and placing it on a more scientific basis, at a much earlier date than otherwise would have been the case, exercised a wide influence, and, particularly in the development of telegraphy, British practice was largely followed in other countries.

After his retirement from the Post Office, Sir William continued to be actively engaged on communication work. Amongst other enterprises, on behalf of the Marconi Company he had acted as administrator general for the Peruvian system of posts, telegraphs and wireless services, a system which he reorganised and placed on a sound basis.

Sir William's professional reputation as an engineer was of the highest, but it is probable he will be best remembered and honoured by his early services in the training of telegraph engineers. A. S. A.

DR. JOHN HOWARD

DR. JOHN HOWARD, of the Fuel Research Station, Greenwich, was killed on January 3 through being caught by an avalanche and swept down a hillside in the neighbourhood of Vent. His companion was Mr. Kenneth F. Armstrong, who was also killed. Dr. Howard was the only son of Mr. and Mrs. Fred Howard. Mr. Fred Howard was formerly Mayor of Holborn.

John Howard was born in London and educated at Oundle School, where he specialised in history before going over to the science side, and was head of Sydney House. In 1927 he became a scholar of Corpus Christi College, Oxford, and took his B.A. degree in 1930 and B.Sc. in 1931, being 'proxime' in the Gibbs scholarship in chemistry. His work was directed by Dr. Hammick, with whom he later published two papers. Whilst at College he became sergeant in the artillery battery of the Oxford University Officers Training Corps and obtained his Certificate B. In 1931 he gained a Commonwealth fellowship and worked at Princeton University with Prof. H. S. Taylor upon "The Adsorptive and Catalytic Properties of *Chromium* Oxide Gel". He submitted a thesis on this subject and was awarded his Ph.D. He published papers in association with Prof. Taylor. He took an active part in a number of sports, particularly in swimming, rugby, fives and shooting. He was captain of the school shooting team at Oundle and won the Stock Exchange Cup for shooting while at Oxford.

Dr. Howard was appointed to the staff of the Department of Scientific and Industrial Research in 1933, and was assigned for duty at the Fuel Research Station, where he commenced an investigation to determine the causes of the deterioration of catalysts in the hydrogenation process. He took a very broad view of the study of science, and his knowledge of history, which was inspired by his mother, who was a graduate in history at Manchester, aroused his interest in the general trends taking place in the fuel industry. As a result he was concentrating upon the effects of the economic changes upon the development of the uses of fuel, and he was acting as the personal assistant of the Director of Fuel Research. He had a very good knowledge of languages and had taken up the study of economics. He had a charming personality and had established a real friendship with his colleagues on the staff.

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WE regret to announce the following deaths:

Prof. Oliver P. Jenkins, emeritus professor of physiology and histology in Stanford University, an authority on American fishes, on January 9, aged eighty-four years.

Prof. Hugo Junkers, founder and until 1932 head of the aircraft firm of that name at Dessau, who was a pioneer in the development of all-metal aircraft, on February 3, aged seventy-six years.

Prof. Emanuele Paternò, formerly professor of general chemistry in the University of Rome, and an honorary fellow of the Chemical Society.

News and Views

Planetary Atmospheres

WE are glad to be able to publish as a special supplement this week a survey of existing knowledge of the atmospheres of the planets, which formed the subject of the presidential address delivered by Prof H N Russell at the recent Pittsburgh meeting of the American Association Prof Russell is known to all astronomers for his work on stellar development, and particularly by his division of stars into the two types of 'giants' and 'dwarfs' in which the temperature is rising and falling respectively In recognition of this and other contributions to astrophysics, he was awarded the Gold Medal of the Royal Astronomical Society in 1921, and he has been similarly honoured by a number of other leading scientific societies In his address Prof Russell first points out that the presence of atmospheres on Jupiter, Saturn, Mars and Venus was proved, many years ago, by telescopic observations of clouds, polar snow-caps and twilight The moon has no trace of atmosphere, nor has Mercury The spectroscope enables information about the composition of these atmospheres to be obtained, but it will not detect hydrogen, nitrogen, helium or other inert gases in such atmospheres Tests for oxygen and water-vapour are complicated by the presence of these substances in the earth's atmosphere By taking advantage of the Doppler shift of the lines when a planet's distance is changing rapidly, this difficulty can be escaped The latest observations at Mount Wilson show no traces of oxygen or water-vapour, either on Mars or Venus The small amount of water required for the Martian polar caps might escape detection Bands due to carbon dioxide have been discovered in Venus, and they indicate a layer of the gas at least two miles thick. The major planets show other bands—increasing in strength from Jupiter to Neptune—all due to methane (CH_4) the simplest hydrocarbon Ammonia gas gives weaker bands in Jupiter and Saturn

PHYSICO-CHEMICAL explanations are available for these facts Small bodies, such as the moon, have not sufficient gravitational attraction to prevent their atmospheres from escaping into space. Middle-sized planets, like the earth, probably lost almost all their initial atmospheres while they were in process of formation, and intensely hot. As the rocky crust solidified, water vapour and carbon dioxide would escape from it and be added to the residual nitrogen, argon and neon. The free oxygen on the earth is probably a product of plant life. Venus appears to be a planet on which life did not start—leaving the carbon dioxide unaffected Large planets would retain hydrogen and all other gases. There is a great excess of hydrogen in the sun If the same were true of the planets, they would cool down into rocky cores, surrounded by oceans thousands of miles deep, and then by atmospheres highly compressed by their own weight. The chemical equilibria in such mixtures have been carefully studied, as they are of industrial importance. At high temperatures and low pressures, hydrogen, nitrogen and carbon dioxide would prevail—at low temperatures and high pressures, hydrogen, methane, ammonia and water The surface temperature of Jupiter is about − 120° Centigrade, and the ammonia is on the point of condensation, probably forming the clouds visible in the planet Saturn is colder, and almost all the ammonia is frozen out In Uranus and Neptune it is completely gone, enabling us to look deep into the atmospheres of hydrogen and methane, which must be very extensive

Inland Water Survey

THE Minister of Health (the Right Hon Sir Hilton Young), and the Secretary of State for Scotland (the Right Hon Sir Godfrey Collins), have appointed a Committee to advise on the Inland Water Survey for Great Britain, on the progress of the measures undertaken and on further measures required and, in particular, to make an annual report on the subject The members are as follows: Col Sir Henry G. Lyons, F R S, Sir Charles H. Bird, Prof. W. S. Boulton, Mr G Dallas, Mr G J Griffiths, Lieut -Col F. Hibbert, Sir Clement D M Hindley, Mr S R. Hobday, Mr. W A. Millar, Mr D. Paul, and Mr. B Verity The secretary to the Committee is Mr. I F Armer, and any communications relating to the work of the Committee should be addressed to him at the Ministry of Health, Whitehall, S W 1. In constituting this Committee, it is stated that the object has been, not to appoint representatives of organisations or interests, but to obtain a body of men of different classes of experience serviceable for the work to be undertaken

THE class of experience chiefly represented upon the Committee is, however, that of water users; and we are disappointed that little attention seems to have been paid to the recommendations of the British Association Committee on Inland Water Survey by the Ministry of Health The need for a scientific survey of the water resources of Great Britain was brought out at the York meeting of the Association in 1932 through a paper in which Capt. W. N McClean described some of his work on river flow The result was the appointment of a strong committee, with Vice-Admiral Sir Percy Douglas, formally hydrographer of the Navy, as chairman, and Capt W. N. McClean as secretary. This Committee produced a valuable report, in which the scientific aspects of inland water survey were clearly presented. It is surprising, therefore, to record that not a single member of the British Association Committee, which was responsible for directing public attention to the whole subject and suggesting a possible programme of work, is included among the members of the Committee just appointed.

Commemoration of Prof. Haber's Death

WHEN Prof Fritz Haber died in Switzerland a year ago, we were glad to publish in the columns of NATURE an eloquent tribute to his greatness, written by one of his old pupils *By the irony of political circumstances* in Germany, the loss of this chemical genius was limited in the journals of that country to a bare announcement, and no obituary notice at all adequate to the influence of his life and work appears to have been published at the time It is not surprising, therefore, that Haber's scientific friends desired to honour his memory on the anniversary of his death, and that a number of them assembled for this purpose in the Harnackhaus of the Kaiser Wilhelm Gesellschaft on January 29, in spite of the official disapproval of the celebration to which we referred last week (p 176) The Berlin correspondent of *The Times* reported that the speakers at the meeting laid emphasis on Haber's devotion to his country and his scientific services Prof Max Planck, who presided, recalled that Haber's synthetic nitrate process had saved Germany from military and economic collapse in the first months of the War "We repay loyalty with loyalty," he said, and he laid particular emphasis on the last three words in his closing tribute to "this great scholar, upright man, and fighter for Germany" Prof. Otto Hahn, director of the Kaiser Wilhelm Institute for Chemistry, and other speakers also bore testimony to the debt owed by Germany to Haber for his outstanding contributions to pure and applied chemistry, and in doing so they expressed the feelings of their colleagues throughout the world It will be remembered that Haber resigned his post at Dahlem in the spring of 1933 and afterwards accepted an invitation of laboratory hospitality at Cambridge, where he went in October of that year He intended to reside there permanently but died at Basle, where he had gone for a short holiday, on January 29, 1934.

British Industries Fair

THE British Industries Fair, 1935, organised by the Department of Overseas Trade, is being held at Olympia and the White City, London, on February 18–March 1. This year the Engineering and Hardware Section is to be held at Castle Bromwich, Birmingham, not simultaneously with the London sections, as previously, but later, on May 20–May 31 The textile and furnishing exhibits will be shown at the White City and the general articles, other than engineering and hardware products, will be exhibited at Olympia There are 1,550 exhibitors at Olympia and the White City, of which more than 750 are from London There are again notable increases in the space taken and the number of exhibitors, compared with last year's figures An indication of the remarkable growth of the Fair is given by the fact that the advance catalogue, which is issued in nine languages, runs to 684 pages, or about 152,000 words. The exhibits of products of scientific interest at the Fair again cover a wide range and reveal markedly the increasing use of scientific products, both materials and instruments, in the field of industry The Committee responsible for the organisation of the united exhibit of scientific instruments is to be congratulated on the important display at Olympia of scientific, optical and photographic instruments. Microscope object-glasses of great refinement of construction; microscope projection apparatus; sound projection apparatus for cinemas, with suit-case sound sets for commercial and educational purposes; various forms of planimeters, pocket cameras and aircraft cameras, distant-reading thermometers; geophysical apparatus for prospecting for gold, minerals and oil—these are but a few examples, selected almost at random, of the products that are being shown in this united exhibit It is worth notice that, until two years ago, practically all the various forms of planimeters used in Great Britain came from abroad; and similarly, the particular geophysical apparatus referred to above was practically a German monopoly It is good to note the enterprise of British scientific instrument manufacturers in these new fields

Whales and Whaling

THE International Convention for the Regulation of Whaling, which came into force last month, is a first and important step towards the permanent preservation of whales and whaling Since whales are killed almost entirely outside territorial waters, any effective measures having these ends in view must be taken by all great whaling countries in common, and one of the most important aspects of this Convention is that it inaugurates international treatment of the whaling industry. The Convention is concerned with the whalebone whales, on which all but a small part of modern whaling is based. It prohibits the capture of right whales, which have been reduced in numbers almost to disappearance, and requires a far more thorough utilisation of the carcases of other whalebone whales than was customary. A quite common practice was to produce oil from the blubber (from which oil is most easily obtained) alone The Convention requires the utilisation of specified parts of the carcase, in which it follows the whaling regulations of the Falkland Islands Dependencies, and recent Norwegian law This is economically sound, since it enables a given quantity of oil to be obtained from fewer whales There is reason for supposing that the whales so saved may in a single season reach some thousands. Lastly, the Convention provides for the collection and collation of the statistics of both capture and manufacture, which should prove of the greatest value in the development of a full and satisfactory regulation of whaling. It makes no provision for the limitation of whaling, and as this will probably prove essential if the industry is to be maintained, it is a step only towards the solution of the main whaling problem; yet it is a valuable advance, in which it is greatly to be hoped the few whaling States not at present signatories will soon see their way to participate.

The Hoover (Boulder) Dam

THE completion, just announced, of the great concrete structure originally known as the Boulder

Dam, but afterwards officially designated the Hoover Dam, across the Colorado River in Black Canyon, which forms the boundary between the States of Arizona and Nevada, at a point about twenty-five miles south-east of Las Vegas, Nevada, marks the attainment of an advanced stage in the execution of the notable Boulder Canyon Project, the Act for which was approved by the United States President in December 1928 The project in its entirety comprises not only the construction of a dam and the formation of an artificial lake, respectively the highest and the most capacious of their kind in the world, but also other incidental works involving an expenditure estimated at the time at 165 million dollars The probable outlay is now given as 385 million dollars The dam has a maximum height of about 730 ft, an extreme length of 1,180 ft, a crest width of 45 ft and a bottom thickness of 650 ft It contains about 4¼ million cubic yards of concrete, and will be the retaining wall of a reservoir having a length of 115 miles and a total cubic capacity of 30,500,000 acre-feet It is designed to impound the flood water of the Colorado River for use in irrigation, and will serve to regulate the flow of that stream so as to improve its navigability, and protect the adjacent valleys from overflow, water shortage and silt accumulation Irrigation and protection from inundation of valuable farm lands in Southern California are the primary and essential objects of the undertaking, but hydraulic turbines of exceptional calibre are also being installed to enable electric power to be generated, the revenues from which will fully recoup the outlay on the entire scheme, which, including a main irrigation canal, 80 miles in length, with an extension 130 miles long to adjacent valleys, is among the most remarkable instances of engineering enterprise in modern times.

Anti-Noise Exhibition

THE Prime Minister will open on May 31 at the Science Museum, South Kensington, an Anti-Noise Exhibition which is being arranged through the Anti-Noise League The Exhibition will remain open throughout the month of June and probably conclude with a congress during the last week. The chairman of the League, Lord Horder, broadcast on the subject of the Exhibition on January 20. It is proposed that the Exhibition shall present a comprehensive survey of the whole problem of noise in its many aspects. The practical co-operation of a number of institutions and public bodies has already been obtained, including the Ministry of Transport, the Air Ministry, the National Physical Laboratory, the Post Office Research Laboratories, the British Broadcasting Corporation, the Industrial Health Research Board, and a number of industrial research laboratories Dr. G. W C. Kaye, of the National Physical Laboratory, is chairman of the Research and Development Section of the Exhibition, Prof. Cave-Browne-Cave, of the Transport and Machinery Section, Mr. Hope Bagenal, of the Building Section, and Sir Henry Richards, of the Organising Committee. The Science Museum has placed generous accommodation, including a cinema theatre, at the disposal of the Exhibition and it is hoped to display many interesting exhibits of noise abatement appliances A small silent house is to be erected which will incorporate the latest architectural and building designs and materials for sound proofing and sound absorption. There will be a number of demonstrations, including silenced pneumatic drills, motor-cycles, typewriters, vacuum cleaners, electric motors, circular saws and so on The latest devices for the measurement, analysis and filtering of noise will be shown, the psychological aspects of noise will receive attention, and experiments on the value of ear defenders, the masking of noises, the effect of noise on loudness of speaking and the use of noise level alarms will claim the interest of most people The effect of noise on output in industry will be illustrated by the results of recent investigations

The Microscope and the Metal Industries

DR C H DESCH delivered a Research and Development Lecture under the auspices of the Royal Institution and the British Science Guild on February 6, taking as his subject "The Microscope and the Metal Industry" Although a careful drawing of a metallic object (the edge of a razor) was published by Robert Hooke in 1665, it was two hundred years before any further use was made of the microscope in the study of metals H C Sorby, a Sheffield amateur, began in 1854 to apply the microscope to polished and etched surfaces of steel and succeeded in identifying correctly a number of separate constituents in the varieties of steel and cast iron available to him It was twenty years before these results attracted any attention, but from that time onwards, the microscope has become an indispensable tool in the metallurgical industry Specimens of metals are ground and polished, care being taken to avoid distortion, and are then etched by means of a suitable reagent which will distinguish between the various constituents All metals and alloys are built up of crystals, and the relative sizes of the component crystals frequently determine the properties of the mass With this object in view, systematic measurements of crystal size are made as metals are passing through the processes of manufacture The reading of a micro-section may be compared with the reading of a map, which conveys the more information the greater the experience of the person using it. A further important application of the microscope is in the study of failures The fracture of crankshafts and other moving parts by fatigue, the cracking of boiler plates and superheater tubes, the breakage of wire ropes, and the cracking of severely cold worked sheets, are typical examples of occurrences on which the microscope is capable of throwing light by indicating the nature of the processes concerned in the failure, and thereby giving a clue as to their origin The microscope has now become an essential part of the equipment of every works dealing with the production of metal, and also with the transformation of metals into useful products on a large scale

Electrical Development in Northern Ireland

An experiment on the co-ordination of electricity distribution is now in its fourth year in Northern Ireland. With the exception of the areas covered by the county borough undertakings of Belfast and Londonderry and by the Antrim Electricity Supply Co., practically the whole of Northern Ireland is included. By an Act passed by the Parliament of Northern Ireland in 1931, a Board was set up, the duties of which were to promote, co-ordinate and improve the supply distribution of electricity generally throughout the country. The Act specially laid down that the Board should not be a profit earning body and that the members should not be financially interested in any company engaged in electrical work. In a paper read to the Institution of Electrical Engineers on January 23, Mr. C. R. Westlake showed that the policy of co-ordination is proving successful, and that the public now has a service of electricity supply not possible under the previous types of control. The main source of supply in Northern Ireland is the harbour power station of the Belfast Corporation, and the area round it is populous. The area taken for primary development covers 1,200 square miles and has a population of about 300,000. The Board can purchase its supplies from any authorised undertakers, and it has adequate equipment to provide for rapid and continuous growth. The problem is to supply energy at rates low enough to secure growth and at the same time to secure sufficient revenue. Notwithstanding the competition of gas companies, more than 50 per cent of the potential consumers are already connected, and where there is no competition, 'saturation' is attained almost immediately. Whole areas hitherto without supply have now amenities usually associated with city life without loss of their rural surroundings. This successful experiment shows the trend of public policy towards the co-ordination of all public utility undertakings.

Japanese Patents and Inventions

On December 23, 1934, the *Japan Times and Mail* published a special "Invention Number" in connexion with the commemoration of the jubilee of the Japanese patent law. The number contains much interesting matter regarding the birth and growth of the Patent Bureau, the increase in the number of patents applied for and sanctioned, and the place of Japan as a great industrial nation. The early history of the Patent Bureau, which in 1933 had a staff of 600, was dealt with in a broadcast address by the Minister of Finance, Mr. K. Takahashi, who was the first chief of the Bureau. The first law enacted by the Government for the protection of inventions, he said, was the so-called expedient monopoly regulations promulgated on April 7, 1871. This, however, was never enforced and in the following year was abolished. A special committee was next appointed to examine the British and American patent laws, and from its work sprang the first Trade-Mark Act in Japan, promulgated on October 1, 1884, followed by the Patent Act of April 18, 1885. This Act came into force on July 1, and No. 1 patent was issued that day to a Tokyo citizen, Zuisho Hotta, for a coating material for ships and iron bridges. For the first twenty years, patents and inventions failed to attract much public attention, and whatever progress was made in industry was due more to successful imitation of Western practices than to original discovery or invention. From the time of the Russo-Japanese War, however, largely through the action of the body now known as the Imperial Invention Association, invention has been encouraged by the Government, and to-day Japan now claims to rank only behind the United States and Germany in the number of patents granted. In several of the contributions to the "Invention Number", recognition is given to the debt Japan owes to foreign countries, but there is also a just sense of pride in the status to which she has attained through her own initiative.

Gas Warfare by Air

The large number of publications in Germany dealing with all aspects of gas warfare which have appeared during the last two years is well known to all in touch with the German technical press, and increasing attention has been devoted to this matter in Great Britain also in recent months. The pamphlet entitled "The Menace of Aerial Gas Bombardment", by Lieut.-Col. N. G. Thwaites, which has now been issued by the *New Commonwealth*, is a welcome statement of the facts in a matter in which conflicting expert opinions have confused the public mind. Reviewing the situation in the different countries of Europe, Col. Thwaites points out that the danger of gas attack from the air is taken very seriously by Germany, France and Italy, while Russia is openly preparing for chemical warfare. In Germany no opportunity is lost of educating the public in anti-gas precautions, and a widely circulated "Handbook of Air Defence" was issued in May 1934. Equipment of the public with gas masks has not yet proceeded very far. In France the public has been made aware of the danger of aerial gas attack, and gas masks are now being sold in large quantities after testing by the authorities. In Italy, anti-gas precautions are dominant among the measures taken for defence against air attack, and the supply and distribution of gas masks has been carried further than in other countries; in Poland a League for Aerial Defence against Gas receives strong support from the Government.

Col. Thwaites proceeds to discuss briefly the measures being taken in Great Britain, as well as the probability and horrors of gas warfare. In his view, the defence measures so far taken are futile, and no merely technical remedy is likely to suffice for long. He considers that the only effective remedy is the abolition by mutual agreement of all national military air forces and the establishment of an international air force for policing purposes. The alternative policy of isolation is no longer possible and the present condition of air strategy puts a premium on the aggressor. The technical difficulties in the

(*Continued on p. 227.*)

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The Atmospheres of the Planets*

By Dr Henry Norris Russell, Research Professor of Astronomy and Director of the Observatory, Princeton University, N.J.

Direct Telescopic Observations

As soon as telescopes became good enough to give a tolerable view of details on the planets, evidence began to accumulate that some of them, at least, possessed atmospheres. Doubtless the first to be noticed were the changes in the markings on Jupiter, which differ radically from one year to the next, and often appear suddenly and last but a few weeks, though *thousands of miles in diameter*. *Only clouds*, forming and dissolving in a Jovian atmosphere, can account for such rapid and capricious changes.

Evidence for an atmosphere on Mars is afforded by the polar caps. The steady shrinkage of these during the summer, accompanied by the growth of the opposite cap during the long cold polar night, is explicable only by the melting or evaporation of deposits of some snow-like substance, which is carried as invisible vapour to the opposite pole, and there deposited. A permanent, non-condensible atmosphere is required for the transport of this vapour.

Venus, when it is considerably nearer to the earth than to the sun, shows a crescent phase, like that of the moon, and for the same reason. As it comes more nearly into line between us and the sun, its crescent narrows, and the horns begin to project beyond their normal positions, so that it has been seen as three-quarters of a circle, and even as a thin bright ring, with a dark interior. This remarkable phenomenon can be seen only when Venus is within about a degree of the sun, and no chance to observe it again will occur until near the end of the present century; but it has been recorded in the past by several competent observers. Such an extension of the horns—and, above all, the ring-phase—can be explained only as effects of twilight; the illuminated atmosphere of the planet being visible across the narrow dark strip of its surface on the side farther from the sun.

For the three brightest planets, then, the presence of an atmosphere is proved by observation, in three quite different but equally conclusive ways, all of which were well known to astronomers before the end of the eighteenth century.

Later observations have added evidence of the same type—a few white spots on Saturn, appearing at irregular intervals of some decades, which change shape, shift and disappear as clouds would do; occasional though fugitive clouds, and a measurable effect of twilight, upon Mars; and elusive markings on Venus, which can be photographed only with ultra-violet light, and change greatly between one evening's observations and the next.

The extent of atmosphere can also be roughly estimated from the results of direct telescopic observation. The surface details of Jupiter (and of Saturn when any appear) may be seen, and photographed, close up to the limb, despite the very oblique angle of view. It is therefore evident that there can be no such extensive gaseous mantle as veils the earth. At least, there is none above the visible cloud surfaces of these great planets—how much there may be below is another matter. The rarefied layer which exists, however, suffices to cut down the apparent brightness of the edge of the planets' discs. The effect of contrast against a dark sky conceals this in an ordinary telescopic view, but the first look at one of these planets in strong twilight shows that it is actually of surprising magnitude.

There is more 'limb-light' on Mars, and there may be more atmosphere above the visible surface—the real surface, this time; but an atmosphere as thick as the earth's, even if free from clouds or haze, would produce a much greater effect.

For Venus the layer which produces the elongation of the crescent is remarkably thin, rising only about 4,000 ft. above the visible surface. But this represents only the part of its atmosphere which is hazy enough to be seen through the glare of our own sky close to the sun. The top of the atmosphere must be much higher; and the bottom, if the visible surface is composed of clouds, much lower, so that its whole amount may be great.

The celestial body which we can observe in far the greatest detail tells quite another story. The moon, viewed telescopically, shows no more atmosphere—whether in the artist's or the physicist's sense—than a bare plaster cast illuminated by a powerful searchlight. Far more delicate tests are possible here than in other instances, and neither refraction nor twilight is present to the minutest degree. Our satellite is naked rock *in vacuo*. Mercury, too, appears to be without an atmosphere, though the evidence is less detailed.

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* From the address delivered on December 31, 1934, at Pittsburgh by Dr. H. N. Russell as retiring president of the American Association for the Advancement of Science.

PRESENCE OF OXYGEN AND WATER VAPOUR

The existence of atmospheres on the majority of the planets—though not on all—is thus established by direct telescopic observation. To determine their composition, we must, as usual, have recourse to the spectroscope; but we meet with two difficulties.

In the first place, many possible atmospheric constituents show no selective absorption whatever in the region accessible to our study. Hydrogen, nitrogen, helium, neon and argon belong to this group, and are hopelessly beyond the reach of our investigation. Secondly, the other gases of the earth's atmosphere absorb too much for our advantage. The worst by far is ozone. Though present in but small amounts, and mainly in the higher layers, it cuts off the whole spectrum short of 2900 A., and deprives us of any hope of studying the most interesting parts of all celestial spectra.

Were we working in the infra-red, water vapour would be almost as troublesome. There are long stretches of the solar spectrum, within the range of present-day plates, in which we can find out little or nothing about the sun's own spectrum. The great wide lines of the water vapour bands, often overlapping, hide almost everything else. The band near 11500 A. is quite hopeless; that at 18000 A. would be worse, if our photographs got so far; one near 9600 A. is still very bad; while in those near 8200 A. and 7200 A. the solar lines can be picked out, with care, among their stronger telluric neighbours.

Oxygen reveals itself by a strong band, with very regularly spaced lines, at λ7594 (Fraunhofer's *A*), the weaker *B* band near 6867, and the much fainter α band at 6277. The terrestrial origin of all these lines is conclusively settled by two tests: first, their changes with the altitude of the sun (varying the air-path) and, for the water vapour lines, with weather conditions; second, the absence of the Doppler shift, due to the sun's rotation, when light from the east and west limbs is compared. The absence of even faint components of solar origin is explained by the high temperature, which dissociates such molecules completely. The intensities of these bands are in inverse order of the abundance of the molecules which produce them—an apparent anomaly, explained by the circumstances of their origin.

The ozone band is part of the main system of the O_3 molecule, and, like all such bands, is very intensely absorbed, a layer of the gas, at its worst, being as opaque as one of metal of equal mass per square centimetre. For water vapour, the main absorption bands lie far in the infra-red, and are very strong—those with which we are now concerned involve high harmonics of the fundamental vibrations. The coefficient of absorption, and the intensity of the bands, diminish rapidly with increasing order of the harmonics and diminishing wave-length.

The oxygen bands are produced by a 'forbidden' transition within the molecule, for which the probability of absorption is exceedingly small. This is why the whole mass of oxygen above our heads (equivalent to a layer two kilometres thick at standard temperature and pressure) produces absorption lines no stronger than the sodium vapour in a Bunsen flame an inch thick, which contains but a minute percentage of the vapour of the metal. The principal bands of oxygen, in the ultra-violet beyond λ1800, are so strong that light of shorter wave-length cannot be observed at all in air. The experimenter must put his whole spectroscope in a gas-tight case, and pump it out to an almost perfect vacuum.

In the visible spectrum, the portions cut out by oxygen or water vapour are very small in extent; but they come exactly in the wrong place—in other words, they hide, line for line, absorption by these same gases which might be produced in the atmosphere of a planet. If the planet's atmosphere was decidedly richer in either constituent than the earth's, we might detect the fact, for the lines in the planet's spectrum would be stronger than in that of the moon. Comparisons of this sort, however, must be made with great precautions. The moon and planet must be at the same altitude when the observations are made (to get equal air-paths). It is not safe, either, to observe the planet early in the evening and wait until the moon rises to the same height, for a change in temperature may have caused the precipitation of water out of the air, though the oxygen, of course, remains the same. With sufficient patience, a time may be found when planet and moon can be seen together, at equal altitudes, and observed almost simultaneously, with the same instrument.

Early observations of this sort were supposed to show the presence of oxygen and water vapour on Venus and Mars; but the careful and accurate work of Campbell, in 1894, led him to the conclusion that there was no perceptible difference in the strength of the bands in the two cases, and hence that the amounts of these two important substances, above the visible surfaces of either planet, did not exceed one fourth of those above an equal area of the earth's.

A more delicate, and very ingenious, test was invented, independently, by two distinguished

American observers, Lowell and Campbell When Mars (or Venus) is approaching us, or receding, most rapidly, the lines in its spectrum are displaced, by the Doppler shift, while lines produced in the earth's atmosphere are, of course, unaffected Were this shift great enough, the planetary and telluric lines would appear double, and the former, even though faint, could readily be detected The greatest available shift is not enough to resolve the lines completely, but measures of the blended lines suffice to show whether any important planetary contribution is present A still more delicate test is afforded by microphotometer measures of the contours of the lines, which would reveal even a slight asymmetry These observations are very exacting—requiring high dispersion and a great deal of light—so that the best evidence is that from the great coudé spectrograph of the 100-in telescope at Mount Wilson St John and Nicholson found, in 1922, that there was no perceptible trace of planetary lines in Venus, and Adams and Dunham, in 1934, have come to the same conclusion in the case of Mars An amount of oxygen, on either planet, equal to a thousandth part of that above an equal area on earth, could certainly have been detected For water vapour, the tests have so far been less delicate, and are not fully decisive—though the quantity present on either planet must be small More delicate tests, with stronger lines, may soon be made on new red-sensitive plates

There can be no reasonable doubt, on quite different evidence, that some small amount of water vapour is actually present in the atmosphere of Mars Radiometric observations of the planet's heat show definitely that the surface rises to temperatures above 0° C at noon every day in the Martian tropics, and at the pole at midsummer, though falling far below freezing at night The polar caps must therefore really be composed of snow, and evaporate into water vapour, even if the pressure is so low that the ice turns directly into vapour without melting The only plausible alternative suggestion—carbon dioxide—would volatilise at much lower temperatures than the actual polar caps do But, judging from the amount of solar heat available to evaporate them, the polar caps must be very thin—probably only a few inches thick The vapour resulting from the gradual sublimation would never attain any considerable density, and might easily fail of detection by the tests which have so far been practicable

IDENTIFICATION OF CARBON DIOXIDE

No such independent evidence is available for Venus; but Adams and Dunham, in 1932, discovered, in the infra-red region of its spectrum, three beautifully defined bands with heads at λ7820, λ7883 and λ8689, and evidently of atmospheric origin They had not then been observed elsewhere, but an immediate suggestion regarding their origin was obtained from the theory of band spectra—by that time well developed The spacing of the individual lines in a band arises from the rotation of the molecule, and depends upon its moment of inertia For the new planetary band, it showed that the otherwise unknown molecule involved must have a moment of inertia of $70\,5 \times 10^{-40}$ c g s units This agreed almost exactly with that of the molecule of carbon dioxide—already known from laboratory observations in the infra-red All doubt regarding this identification was removed when Dunham, passing light through 40 m of carbon dioxide at a pressure of 10 atmospheres, found that the strongest of the bands found in Venus was faintly absorbed Recently, Adel and Slipher, using a path of 45 m. through gas at 47 atmospheres pressure, have found the bands considerably weaker than as they appear in the planet They conclude that the amount of carbon dioxide above the visible surface of Venus is at least two mile-atmospheres—that is, equivalent to a layer two miles thick at standard atmospheric pressure and temperature The whole amount above the planet's solid crust may be much greater For comparison, it may be noted that the whole atmosphere of the earth amounts to five mile-atmospheres, and the oxygen in it to one and a quarter

These bands do not show in the solar spectrum, even when the sun is setting But there is very little carbon dioxide in the earth's atmosphere, and the whole amount in the path, even at sunset, amounts to only thirty feet under standard conditions

The weak absorption in these bands, like that in the visible bands of water vapour, arises because they involve high harmonics of the fundamental vibration frequencies—in this case, the fifth.

AMMONIA AND METHANE IN THE MAJOR PLANETS

So far, we have had to do with bands of familiar and readily identified molecules, but the major planets have been much more puzzling

Jupiter shows a conspicuous band in the orange, which was discovered visually by Huggins in the earliest days of spectroscopy, and fainter ones in the green These appear more strongly in Saturn, but only in the spectrum of the ball of the planet, and not at all in that of the ring—which might be anticipated, since the ring consists of a multitude of tiny isolated satellites, and should be quite devoid of atmosphere Uranus, though its light is faint, shows the same bands, much more strongly, and many others in addition One of these, which closely coincides with the *F* line of hydrogen (λ4861), led Huggins to conclude that the planet's atmosphere was rich in hydrogen

This interpretation, though quite permissible at the time, was erroneous, for the line is absorbed only by dissociated *atoms* of hydrogen, which will not be present except at very high temperatures

The bands cut out so much of the red and orange light that the whole disc of Uranus appears decidedly green—an unusual colour, noticed from the time of the planet's discovery

In Neptune's spectrum, the bands are of enormous strength, cutting out the red almost entirely and making the planet look still greener. They are hard to observe visually in so faint an object, and the full realisation of their intensity came only with the admirable photographs of V. M. Slipher, in 1907 In later years, and with modern plates, Slipher has extended his observations far into the red, finding bands of ever-increasing strength—up to λ10000 for Jupiter, where there is light enough to follow the spectrum farthest.

For more than sixty years after their first discovery, and twenty-five after Slipher's spectrograms, these bands presented one of the principal unsolved puzzles of spectroscopy—for no one had duplicated them in the laboratory. To be sure, one group, near λ7200, agrees fairly well with a band of water vapour, but the still stronger water-bands deeper in the red are absent, so that this must be a chance coincidence

When the radiometric measures of Coblentz and Lampland, and of Nicholson and Pettit, showed that the temperature of the visible surfaces of Jupiter and Saturn must be well below – 100° C, while Uranus and Neptune are doubtless colder, the range of possibilities was very much narrowed. But it was not until 1932 that a young and brilliant German physicist, Rupert Wildt, realised the solution of the problem

Other gases, like water vapour and carbon dioxide, have strong fundamental absorptions in the infra-red, and fainter harmonics in the more accessible part of the spectrum, which demand a long absorbing path in the laboratory to bring them out Utilising observations of this sort, Wildt showed that certain bands in the spectrum of Jupiter near λ6470 and λ7920 agreed with those of ammonia, and others, at λ6190, λ7260, and λ8860, with bands of methane The original comparison was not quite conclusive, for with the moderate dispersion then employed the planetary bands had not been adequately resolved into their component lines. This was soon accomplished by Dunham, who found so complete a coincidence of the accurately measured individual lines that both identifications were put beyond all question. For ammonia, more than sixty lines were found to agree, and for methane eighteen lines in part of one band Some expected band lines were naturally blended with solar lines; but not one of importance failed to appear.

From these comparisons, Dunham estimates that the quantity of ammonia gas above the visible surface of Jupiter is equivalent to a layer ten metres thick under standard conditions In Saturn it is less

The climax of the tale came in 1934, when Adel and Slipher announced that practically all the bands had been identified, and were due to methane The 45-m path, and the 40-atmosphere pressure, got enough of the gas into the way of the light to produce bands intermediate in intensity between those in Jupiter and in Saturn At this high pressure, the lines flowed together, and produced diffuse bands, but the agreement of these with the planetary bands was so complete as to be decisive

A further, and wholly conclusive, test could be added The fundamental frequencies of vibration of the methane molecule were already known, from observations in the infra-red For the higher harmonics of these vibrations, the frequencies are not exact multiples of the lowest, but nevertheless bear a simple numerical relation to them (as is well known in the case of other gases) Applying this test, the strongest bands (including Huggins's band in the orange, and the one coincident with the blue hydrogen line) were found to be harmonics, from the third to the eighth, of one of the fundamental frequencies, while another slower vibration was represented by all its harmonics from the eighth to the sixteenth The remaining bands were accounted for by combinations of these harmonics with other known frequencies, all of types consistent with the well-established rules which govern band spectra. Thirty-six bands in all have been identified. Many of these appear only in Uranus and Neptune, and have not yet been produced in the laboratory, but the harmonic relations just mentioned make their identification certain. The higher gaseous hydrocarbons, ethane, ethylene and acetylene, all have bands in places clear of disturbance by the methane; and all were looked for in vain. All the planetary bands of any importance are accounted for by methane alone—it is a clean sweep

From the published data, it appears that the amount of methane above the visible surface of Jupiter is of the order of one mile-atmosphere. There must be much more on Uranus, and especially on Neptune, but we cannot yet estimate its amount.

There is still plenty of work to do upon these bands; but mainly for the theoretical investigator. Adel calculates that the band at λ5430, when fully resolved, should consist of eighteen different overlapping systems of many lines each. Fortunately, the astrophysicist need not wait to draw his conclusions until this has been completely analysed.

ATMOSPHERES IN RELATION TO PLANETARY MASSES

The results of observation can be summarised in a sentence. Large planets have atmospheres containing hydrogen compounds; middle-sized planets, atmospheres containing oxygen compounds; and small planets no atmospheres at all. The reason, in the last case, was found by Johnstone Stoney in 1897. It is simply that small bodies have not sufficient gravitative power to keep their atmospheres from diffusing away into the vacuum of interplanetary space. At the surface of any planet, there is a certain velocity of escape, depending only on its mass and radius. A body projected from its surface, in whatever direction, with this or any higher velocity, will fly off in a parabolic or hyperbolic orbit and never return—unless, indeed, it meets with some obstacle or resistance on its outward way. For the moon this velocity is 2·4 km. per second; for the Earth, 11·2 km./sec.; for Jupiter, 60 km./sec.

Now the molecules of any gas are continually flying about in all directions, with average speeds which depend upon their weights. At 0° C. the average speed for a hydrogen molecule is 1·84 km./sec., for oxygen, 0·46 km./sec., for carbon dioxide, 0·39 km./sec. If an atmosphere of hydrogen could be put upon the moon, every molecule that was moving but a little faster than the average would fly off at once into space, unless it was thrown back by collision with another, and the atmosphere would diffuse away in a very short time. With an escape velocity three times the average speed, enough fast-moving molecules would get away to reduce the atmosphere to half its original amount in a few weeks (according to Jeans). The rate of loss falls off very rapidly beyond this, so that, with an average velocity one fifth that of escape, the atmosphere would remain for hundreds of millions of years. The moon's surface reaches a temperature exceeding 100° C. during every rotation, and it follows that neither air nor water-vapour could permanently remain above its surface. If at any time in its past history, it has been really hot, like molten lava, it could have retained no trace of atmosphere.

For Mercury, the escape velocity is half as great again as for the moon; but the planet, being so near to the sun, is much hotter, and it, too, cannot retain an atmosphere. Mars, with an escape velocity of 5 km./sec., could not hold hydrogen; but should retain water-vapour—as it appears to have done—and all heavier gases. Venus and the earth, at their present temperatures, should retain even hydrogen, and the major planets would do so even if incandescent.

This reasoning explains the cases of Mercury and the moon, and leads to the important conclusion that all smaller bodies, such as the asteroids and satellites, must be wholly devoid of atmosphere—except perhaps bodies like Neptune's satellite, which is relatively massive and must be very cold. We cannot be sure about Pluto, for we know neither its size nor its mass; but it is probable that, at most, it may have a thin atmosphere, like Mars.

The same principle was invoked, shortly after its discovery, to explain the great difference in mean density between the major and the terrestrial planets. The Moon, Mercury, Mars, Venus and the Earth all have densities between 3·3 and 5·5 times that of water. The rest are almost certainly what we know the Earth to be, spheroids of rock, with cores of metallic iron of varying sizes. For the major planets, the densities range from 1·6 for Neptune to 0·7 for Saturn. Moulton suggested, about 1900, that they contained great quantities of light substances, which the smaller terrestrial planets had not been able to keep from diffusing away into space. This has been fully confirmed by later studies.

From the ellipticity of a planet and the changes in its satellites' orbits caused by the attraction of its equatorial bulge, information may be obtained regarding the degree to which the density increases toward its centre. Applying this to Jupiter and Saturn, Jeffreys concludes that they contain cores of rock and metal, like the inner planets, surrounded by vast shells of ice—frozen oceans thousands of miles deep—and above this, again, atmospheres of great extent. Throughout most of the atmospheres, the pressure must be so great that the gas is reduced to a density as great as it would have if liquefied, or even solidified, by cooling. Indeed, Wildt believes that the enormous pressure would actually solidify even the 'permanent' gases.

Now this outer layer is of low density—less than 0·78 for Jupiter and 0·41 for Saturn—according to Wildt's calculations. This excludes all but a few possible constituents. Frozen oxygen has a density of 1·45, nitrogen 1·02, ammonia 0·82. Only hydrocarbons (methane 0·42, ethane 0·55), helium (0·19) and hydrogen (0·08) come within the limits even for Jupiter. We can therefore conclude, from considerations of density alone, that the outer parts of Jupiter probably, and of Saturn certainly, contain great quantities of free hydrogen or helium. Uranus and Neptune are similar to Jupiter.

EVOLUTION OF ATMOSPHERES

It is generally believed that the planets have been produced, in some way or other, from matter ejected or removed from the sun No really satisfactory theory of the process of formation has yet been devised, but no other hypothesis has yet done better, and the isolation of the sun and planets in space makes a common origin highly probable

Now we know the composition of the sun—at least of its outer layers—much better than we do that of the planets Quantitative spectroscopic analysis, though still beset with difficulties, has advanced far enough to show that most of the sun's outer layers is composed of hydrogen, next come helium, oxygen and carbon, followed by nitrogen, then silicon and the metals A mass of matter removed from the sun and allowed to cool without serious loss would therefore closely resemble the major planets If small enough to lose all its atmosphere, it would be like the moon or the asteroids—though there are difficulties in seeing how such small masses could have escaped diffusing away altogether before the more refractory constituents solidified

The history of a body of intermediate mass is more interesting Hydrogen and helium would be lost while the body was still very hot. So would most of the other light gases such as neon and nitrogen (which at the temperature even of the sun's surface is dissociated into atoms) Free oxygen, too, would escape, but a good deal might be retained in combination with silicon and the metals As the gaseous mass cooled, by expansion and radiation, drops of molten metal and lava would form within it, as Jeffreys suggests, and fall toward the centre, building up a molten core After the first turbulence was over, there would remain a molten planet surrounded by an atmosphere containing heavy inert gases such as argon, perhaps some carbon dioxide, and as much of the nitrogen and neon as had failed to escape Menzel and I, a few years ago, noticed that neon, while apparently fully as abundant in the stars and nebulæ, is but 1/500 as abundant in the earth's atmosphere, while nitrogen, which is cosmically an abundant element, showing strong spectral lines, forms but a very small portion of the earth's mass It appears, therefore, that a mass of the earth's magnitude must have lost almost, though not quite, the whole of its primitive atmosphere

Still following Jeffreys, it appears that, as the molten earth cooled, the two thousand mile deep sea of lava solidified first at the bottom (where the melting point was greatly raised by pressure) and so gradually to the surface During this process, great quantities of gases, mainly water vapour, must have been evolved from the solidifying magma and escaped to the surface, forming a new atmosphere which now would not escape, since the surface was cooler With solidification would come rapid superficial cooling and an ocean would bathe the rocky crust, leaving an atmosphere of moderate extent Carbon dioxide—evolved from the magma, and perhaps partly primitive—would be a major constituent, along with nitrogen, argon, neon and other minor left-overs The presence of free oxygen seems very unlikely, for practically all volcanic rocks and gases are unsaturated with respect to this element —the former containing much ferrous iron, and the latter being often actually combustible when they meet the air

The present rich supply of oxygen appears to be a by-product of terrestrial life (This suggestion is more than a century old.) The earth, indeed, may be regarded as an intensively vegetated planet, from the atmosphere of which the greedy plants extract the remaining residue of carbon dioxide so rapidly that if it were not returned to the air by combustion, respiration and decay, the whole supply would be exhausted in a decade or so Oxygen removed from the atmosphere by these processes is speedily returned by plants, but there is another process of slow depletion which is irreversible During rock-weathering, about half the ferrous iron of the rocks is oxidised to the ferric state Goldschmidt (from whose admirable geochemical papers the present discussion is borrowed) concludes that the amount of 'fossil' oxygen thus buried in the sedimentary rocks is at least as great as that now present in the atmosphere, and may be twice as great An amount of carbonaceous or other organically reduced material equivalent to both the free and the fossil oxygen must also be in the sediments—which is not unreasonable Given time enough, this inexorable process of rock-decay might exhaust the remaining oxygen of our atmosphere, and put an end to all that breathes But this danger is indefinitely remote—a billion years away anyhow, since life has lasted that long, and only half the oxygen has been used up, and probably much longer, for volcanic gases are still carrying 'juvenile' carbon dioxide into the air that has never been there before

It is of no small interest, however, to look at Mars and see there what looks very like the end of this process The reddish colour of the planet—unique among the heavenly bodies—is just what might be expected, and indeed is almost inevitable in a surface stained with ferric compounds (The unoxidised rocks of the moon are grey or, at most, brownish) Wildt suggests that, in the thin atmosphere of Mars, the ozonised layer produced by the action of ultra-violet light at the top of the atmosphere should be near the surface—not high up as it is here—and that oxidation processes at the planet's surface might thus be accelerated.

It would be premature, however, to conclude that Mars must be a lifeless planet. The depletion of oxygen would be very slow, and plant-life would probably adjust itself—as it has done on earth in response to far more rapid climatic changes. Whether animal life, if ever present, could have survived, is speculation. A race of no more intelligence and engineering skill than our own could presumably meet the situation and survive in diminished numbers breathing electrolytic oxygen—provided that it paid any attention to changes so slow as to be imperceptible in a thousand generations!

While Mars resembles the final stage of our suggested process, Venus seems to be at the beginning, and much like what a lifeless earth would be. We do not know how life began here, but conditions may well have been much less favourable on Venus. Wildt concludes that the powerful 'blanketing' effect of the atmospheric carbon dioxide, combined with the stronger solar radiation, may raise the temperature at the planet's actual surface to 100° C. or higher—in which case the failure of life to develop is not surprising. The real puzzle is the apparent absence of water on the surface of Venus. The planet is almost a twin of the earth in size, mass, density and so on, and one might have expected an ocean of comparable volume. Wildt suggests that all the water has gone into hydrated minerals; but how this could happen unless there was much less there originally than on earth is hard to understand.

COURSE OF CHEMICAL CHANGES

For the major planets, we have to consider the course of events in a cooling mass containing an excess of the lighter elements and especially of hydrogen. The condensation of the refractory constituents should take place much as for a smaller body. The principal constituents of the rocks, however—potassium, sodium, magnesium and calcium, and likewise silicon—are not reduced from their oxides by hydrogen, and would form rocks not unlike those of the earth. But at high temperatures the oxides of iron are reduced by hydrogen. My colleague, Prof. H. S. Taylor, remarks that the drops of molten lava falling through a hydrogen atmosphere reproduce fairly closely the conditions of a blast furnace. We may conclude then that most of the iron would go into the core and less into the rocky shell.

After the core solidifies, the remainder of the mass will remain fluid over a wide range of temperature. Its principal elementary constituents will be hydrogen, helium, oxygen, carbon and nitrogen, with smaller quantities of the other inert gases, sulphur and the halogens.

The principal reactions which occur in such a gaseous medium at different temperatures and pressures have been carefully studied, for, in addition to their theoretical interest, they are of great practical importance in chemical industry.

When oxygen, carbon and hydrogen are considered, the main reaction is

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

The formation of methane is accompanied by diminution of volume; hence it will be favoured by high pressure. High temperature works the other way; from the free-energy data it appears that, at 1000° C. and atmospheric pressure, the equilibrium inclines to the side of carbon dioxide, even in the presence of a large excess of hydrogen. Below 300° C. practically all the carbon should go into methane; at about 600° the amounts of the two gases should be comparable.

With hydrogen and higher hydrocarbons, the tendency of the reaction is always toward methane at low temperatures. With saturated hydrocarbons, this involves no change of volume and should not be affected by pressure. Formation of methane from unsaturated hydrocarbons should be favoured by high pressure. The exclusive presence of methane in the planets' atmosphere might thus have been predicted.

The formation of ammonia from its elements, in accordance with the equation

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

liberates less energy. With excess of hydrogen, and at atmospheric pressure, the amounts of nitrogen and ammonia should be equal between 200° and 300° C.; ammonia should predominate at lower temperatures, and at higher pressures. The oxides of nitrogen are endothermic, and so would tend to dissociate, rather than to form.

We may now form a definite picture of the successive reactions which will occur in the atmosphere of a cooling major planet. At temperatures of about 1000°, the predominant hydrogen will be mixed with steam, free nitrogen and carbon dioxide—the carbon monoxide which occurs in stellar atmospheres having long ago been completely oxidised. With falling temperature, the carbon dioxide will be converted into methane before the water reaches its critical temperature and begins to condense. After most of it has been precipitated, the nitrogen will go over into ammonia. These reactions, however, will run their course at these relatively low temperatures only with appropriate activation. For the formation of methane, an excellent catalyst is available in the partially reduced oxides of iron which should be present on the rocky surface exposed to hot hydrogen. These would be equally good for the ammonia, but they may be at the bottom of the sea by the time the proper temperature is reached. An adequate activation, however, would be furnished by electrical discharges—and, if terrestrial thunderstorms are any guide, these should be abundant so long as vapours arising from the hot ocean are being condensed. When the temperature has fallen to that which the earth at present enjoys, there will be an extensive atmosphere of hydrogen, mixed with the simple hydrides—methane, ammonia and water vapour—along with any inert gases which may all along have been present, but with little or no free nitrogen or carbon dioxide. Below this will be an ocean—perhaps very deep, strongly alkaline with ammonia, and incidentally containing in solution any compounds of sulphur and the halogens which may originally have been present. The conditions in such an alkaline ocean—its action on the rocky bed, the compounds which it will hold in solution, and the deposits which it may form—would be of great interest, but are outside our present scope.

With further cooling the water will freeze, but at a temperature below 0° C. depending on the percentage of ammonia. With one part of the latter to two of water, the freezing point would drop to $-100°$ C., but it is doubtful if there is enough ammonia for this. The major planets—even Jupiter—are still colder, and the water must be thoroughly frozen out of their atmospheres, leaving only ammonia and methane. The ammonia, indeed, must be at the point of precipitation. Dunham has obtained in this way a minimum temperature for Jupiter's visible surface. The ten metres of ammonia above the surface, under the planet's surface gravity, should exert a pressure of 1·5 mm. (on the familiar laboratory scale). The vapour tension of the solid (below the triple point) has this value at $-107°$ C. At a lower temperature, the observed quantity of ammonia could not exist in the atmosphere—it would partially condense itself by its own weight.

If the atmosphere consists mainly of hydrogen this limit may be lower, for the mean molecular weight is diminished, and the partial pressure of the ammonia in the same proportion. With a large excess of hydrogen, the pressure may be reduced to one sixth of the previous value and the limiting temperature to $-120°$ C.

The direct radiometric observations of Jupiter indicate a temperature of about $-135°$, but this determination is complicated by large and rather uncertain corrections for the absorption of infra-red radiation in the atmospheres of the earth and the planet, so that the agreement is about as good as could be expected. It is, therefore, very probable that the clouds which form Jupiter's surface are composed of minute crystals of frozen ammonia. A perfectly absorbing and radiating planet, at Jupiter's distance and heated exclusively by the sun, would have a mean temperature of $-151°$ C. The excess in the actual temperature may be attributed partly to the fact that we observe the sunlit (and warmer) side, partly to the 'greenhouse' effect of the atmosphere, which lets in the short-wave radiation from the sun much more easily than it lets the long-waves emitted from the planet's surface out again; and partly, perhaps, to some residual internal heat in the planet. The existence of the latter is made probable by the rapid changes in the cloud-forms, which often suggest the ascent of new material from below. The variety of colours upon the surface, which range from clear white through pinks and browns almost to black, remain unexplained.

On Saturn, where the ammonia bands are fainter than on Jupiter and the surface gravity is less than half as great, the limiting temperature may be 10° or 15° lower. The radiometric observations indicate about the same difference.

Uranus and Neptune, being farther from the sun, should be still colder. The ammonia should be frozen out of their atmospheres, leaving them clear to a greater depth, which may explain the extraordinary strength of the methane bands in their spectra. The methane itself must be nearly ready to condense on Neptune, despite its very low boiling point. Assuming, roughly, that Neptune has six mile-atmospheres of methane above its surface, the pressure, due to this alone, would be about 500 mm. and the limiting temperature $-165°$ C. A large excess of hydrogen might reduce this to $-183°$. Solar radiation alone would maintain a mean temperature near $-220°$. Whether the difference arises from the powerful 'greenhouse' effect of the methane itself, or from internal heat, cannot yet be determined. It may be, however, that if the methane could once be frozen out of Neptune's atmosphere, the surface temperature would fall so much that it would stay frozen, and leave the planet with an atmosphere which, apart from the inevitable Rayleigh scattering, exerted no influence upon visible light.

The problem of planetary atmospheres, so perplexing a few years ago, is now far advanced toward its solution. Towards its interpretation many sciences have contributed—astronomy, physics, chemistry, geology, biology and technology. No one of them alone could have resolved the difficulties. It may, therefore, be appropriate that the attention of so general a scientific gathering may have been invited for a while to it: for it truly illustrates the old motto "In union there is Strength".

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organisation of an International Air Police are insignificant compared with the difficulty of finding any practical defence scheme which has the remotest chance of becoming effective.

Civil Aviation Wireless Plans

THE plans which have been approved for the establishment of new civil aviation wireless stations in Great Britain will provide for the establishment of a chain of wireless stations throughout the country, so as to afford full facilities for direction-finding, for communication with aircraft, and between airports. Three new stations came into operation last year, at Hull, Portsmouth and Nowtownards (Belfast). A further six are under construction and will be placed at suitable sites during 1935. These sites are being chosen with the object of providing a direction-finding network covering the new internal routes, as well as to serve the needs of individual aerodromes. The equipment will be mounted on vehicles capable of being easily moved from place to place. A limited number of permanent stations of higher power are also to be erected. The first of these will be established at Heston Airport to relieve the growing congestion at Croydon. It is also the intention of the local authorities to build a station in the Channel Isles. Three new permanent direction-finding stations, in addition to those already existing at the same points, are being brought into operation at an early date on the Continental airway, at Pulham, Lympne and Croydon. The radio-beacon at Croydon is now being modified to operate on the aural principle, thus making it available for any aircraft fitted with an ordinary receiver. On the completion of this reorganisation there will be available for the assistance of aircraft flying on the Continental routes seven direction finders, seven transmitters and one radio beacon.

A New Depth-Sounding Recorder

THERE are several types of marine devices for finding the depth of the sea by means of 'echo-sounding'. One or two of these not only give isolated indications of the depth of the sea, but also provide a more or less continuous record of the sea bed. The British Admiralty uses a low-frequency type of oscillation which is reflected from the bottom of the sea, the time of going and returning being marked on an electro-chemical recorder. A high-frequency system using the vibrations of a quartz piezo-electric oscillator, devised by Langevin and Chilowsky, has been developed commercially in Great Britain by the Marconi Sounding Device Co. An entirely new type of high-frequency echo depth recorder which possesses important advantages was described to the Institution of Electrical Engineers on January 2 by A. B. Wood, F. B. Smith and J. A. McGeachy. This device can give a continuous record of the depth of water beneath a survey motor-boat of about 2 ft. draught travelling at full speed. According to the specification, it had to measure a depth ranging up to 200 feet with a maximum inaccuracy of about one foot. The method employed gives a practical application of the phenomenon of magneto striction. Two oscillators of this type—a transmitter and a receiver—are mounted in water filled tanks and fitted in a chosen position in the motor-boat. The transmitter is excited into resonant vibration at regular intervals of time depending on the range of depth to be recorded. A short train of high-frequency sound waves is directed vertically downwards to the sea-bed and reflected back to the receiver. The induced currents are amplified, rectified and passed through a recorder. During the time the sound impulse is travelling from the transmitter to the receiver via the sea bed, the recording point has travelled a corresponding distance on the paper. The time for the going and return journey is thus found. The method has been proved satisfactory for depths exceeding 400 fathoms.

Vital Statistics for 1933

LAST week (p. 181) we printed a note referring to the provisional figures of the vital statistics for 1934. The Registrar General's Statistical Review for 1933, Tables (Part II, Civil) is now available (London: H.M. Stationery Office. 2*s*. 0*d*.) It includes a table showing the populations of England and Wales, Scotland and Ireland as enumerated at each Census from 1821 until 1931, and as estimated for each year 1894–1933 inclusive. The population of England and Wales is now estimated as 40,350,000 at the middle of 1933, the 1931 Census figure being 39,952,377. The births registered during 1933 numbered 580,413 a decrease of 33,559 on the previous year's figure. The consequent birth rate of 14·4 per 1,000 population is the lowest recorded for England and Wales, being 0·9 below that for 1932 the previous lowest, and 1·4 below that for 1931. The only countries showing a lower rate in 1933 were Sweden (13·7) and Austria (14·3). The proportion of the sexes in the births registered during the year was 1,046 males to 1,000 females.

Association of American Geographers

THE thirty-first annual meeting of the Association of American Geographers, with Dr. Wallace W. Atwood presiding, was held at the University of Pennsylvania, Philadelphia, on December 27–29. Forty-nine papers were presented, including six in the field of geomorphology, five in climatology, and two in cartography. The remaining papers ranged the whole field of geography, and included discussions of particular problems or areas. A half-day session was devoted to a conference on regional geography. As retiring president, Dr. Atwood addressed the Association on "The Increasing Significance of Geographic Conditions in the Growth of Nation States". For the forthcoming year the following officers were elected: *President*, Prof. Charles C. Colby, University of Chicago; *Vice-President*, Col. C. H. Birdseye, U.S. Geological Survey; *Treasurer*, Prof. John E. Orchard, Columbia University; *Councillor*, Prof. Kirk Bryan, Harvard University, *Secretary*, Prof. Frank E. Williams, University of Pennsylvania.

Congress on Dog Breeding

AN event of considerable interest to geneticists, psychologists, and especially to dog fanciers, is to take place at Frankfort on Main on April 22–25, when the Fédération Cynologique Internationale (F C I) is to hold its third congress, which will be followed (April 26–28) by a dog show, open to all the world, and providing classes for all the known breeds Discussion at the congress will deal mainly with the inheritance of the physical and mental characters of the dog, and papers will be presented by Prof Henseler, of the Institut fur Tierzucht und Zuchtungsbiologie in Munich, Prof Pirocci, of Milan, Dr Méry, of Paris, and Major Most, of Berlin Particulars concerning membership and programmes may be obtained from Fr Bazille, Rotenwaldstr 83a, Stuttgart-W

Holly Lodge Farm

ACCORDING to *The Times* of February 6 the Conservative Parliamentary Agricultural Committee on February 5 unanimously adopted the following resolution "That in view of the authoritative opinions on the educational and research value of the Holly Lodge and Crown Farms, Walton-on-Thames, especially in view of the Government's policy for the greater home production of fruit, vegetables, and flowers to replace foreign imports, this Committee expresses the earnest hope that these farms will not be destroyed under the reservoir scheme of the Metropolitan Water Board "

Announcements

PROF A C SEWARD professor of botany in the University of Cambridge, has been elected president of the South Eastern Union of Scientific Societies in succession to Prof H L Hawkins The annual congress will be held at Bournemouth on June 26 29

PROF A L GOODHART, professor of jurisprudence, Oxford, Sir Walter Moberly, chairman of the University Grants Committee, and Prof. G P Thomson, professor of physics, Imperial College of Science, have been elected members of the Athenæum Club under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

ON February 18 in the Lecture Hall of Manson House, Portland Place, Col MacArthur, late R A M C., will be presented with the Chadwick Gold Medal and Prize of £100 which, under the scheme of the trust, may be awarded once in five years to the medical officer of the Navy, Army or Air Force who has most distinguished himself during that period in promoting the health of the men of the Service to which he belongs.

SIR PETER CHALMERS MITCHELL, who has been a member of Council since 1900 and secretary since 1903 of the Zoological Society of London, retires from that office on April 29, 1935 It is therefore proposed to present to the Society a portrait in oils of Sir Peter, by Mr William Nicholson Fellows and friends of the Society are invited to send contributions to the Portrait Secretary, c/o F W Bond, Zoological Society of London, Regent's Park, N W 8.

AT the meeting of the Industrial Research Council, Irish Free State, on February 2, it was announced that Mr Eugene Boyle has been appointed chemical engineer for research on waxes under Prof J Reilly in University College, Cork

AT the twenty ninth annual meeting of the Botanical Society of America on December 27–29 in Pittsburgh, Pennsylvania, the following elections were made *President*, Dr Aven Nelson, University of Wyoming, *Vice-President*, Dr K M Wiegand, Cornell University, *Corresponding Members*, Sir David Prain, lately director of the Royal Botanic Gardens, Kew, Prof G Haberlandt, emeritus professor of botany, University of Berlin, Prof Alvar Palmgren, professor of botany, University of Helsingfors

THE first (January) issue of the *Traveller*, the quarterly journal of the University Travel Guild, contains short accounts of excursions of scientific, historical, architectural, musical, etc., interest which are being arranged by the Guild in 1935 Tours of scientific interest include "Palestine of the Bible", under the leadership of Dr E W G Masterman; "Dalmatia a Botanical Tour", under the leadership of Dr W. B. Turrill, and Roman France Copies of the *Traveller* (price 4*d*, or including postage 6*d.*) and further particulars of the University Travel Guild can be obtained from its offices, 25 Cockspur Street, London, S W 1

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An inspector of mine beacons in the Department of Mines, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2 (Feb 16) A lecturer in botany and physics at the Cheltenham Technical College—The Secretary (Feb 18) A technical officer in the Admiralty Technical Pool—The Secretary to the Admiralty (C E Branch), Whitehall, London, S W 1 (Feb. 18) A lecturer in hygiene and public health in the Charing Cross Hospital Medical School, 62 Chandos Street, W C 2 —The Dean (Feb. 20). An assistant inspector of guns (metallurgy) in the Metal and Steel Factory, Ishapore (Indian Ordnance Department)—The Secretary, Military Department, India Office, London, S W 1 (Feb. 20). A general manager and engineer in the Electricity Department of the Metropolitan Borough of Battersea—The Town Clerk, Battersea Town Hall, London, S.W.11. An assistant chemist, a junior chemist, and a biologist on the staff of the Research Association of British Flour Millers—The Director of Research, Old London Road, St. Albans.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 235

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Light of the Night Sky

I HAVE succeeded in exciting the auroral green line under conditions which indicate that it must have been produced in a manner similar to that in the light of the night sky In order to describe my experiments properly, it is necessary first to recall the excitation of the green line in active nitrogen[1] In that experiment it was possible for the first time to produce the green line under conditions which give some clue to its production in both the aurora and the night sky, since there are metastable nitrogen molecules in active nitrogen, and one would certainly expect metastable nitrogen to play an important rôle in the upper atmosphere My recent discovery of a new modification of active nitrogen[2], the afterglow of which was a very faithful reproduction of that part of the auroral spectrum which is due to nitrogen, added an argument for the hypothesis that the green line is excited by metastable nitrogen molecules

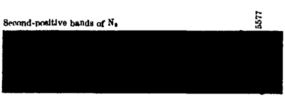

FIG 1

In the new experiments, a very small amount of oxygen, about one per cent, was introduced into the tube in which the new afterglow was discovered The discharge, and not the afterglow, was photographed with the current in the tube interrupted periodically. At first the interruptions were spaced so that the current was on long enough to allow the current in the bulb of the tube to reach its full value The discharge in the bulb was green-white, and the green line was absent under these conditions When the current was interrupted more rapidly, the discharge in the bulb was much weaker and its colour was red Certain very profound changes took place in the spectrum of the discharge in the bulb The most important one was the presence of the green line, with an intensity which resembles very closely its intensity in auroral and night sky spectra, and also unaccompanied by other oxygen lines (Fig. 1) The first-negative bands of N_2+, which are strong in the discharge when the current is allowed to reach its full strength, were almost completely missing The second-positive bands of N_2 were present The recently discovered Vegard-Kaplan intercombination bands of nitrogen were excited, but in the rapidly interrupted discharge the high wave-length members of the system increased greatly in intensity relative to the other N_2 bands, as compared with their intensity in the slowly interrupted discharge The Goldstein bands, to which attention was directed recently by Hamada[3] in connexion with the light of the night sky, were missing in the rapidly interrupted discharge, although they were present in the slowly interrupted one.

The most important results of these experiments are the excitation of the green line, the increased intensity of the long wave length members of the Vegard-Kaplan system and the absence of the Goldstein bands The first two indicate that the members of the Vegard Kaplan system probably occur in the night sky, and the absence of the Goldstein bands casts some doubt on Hamada's identification of the X_1 and X_2 lines as members of that system The absence of the first negative bands is in good agreement with their very feeble excitation in the light of the night sky Longer exposures have been started in an attempt to observe the red oxygen lines which usually accompany the green auroral line and also to observe the visible members of the Vegard-Kaplan system It is believed that we have a very good reproduction of the light of the night sky in these experiments and hence a means for identifying the radiations which are actually observed in the night sky

With regard to the identification of the two X_1 and X_2 lines, 4416 and 4168, it may be said that Dufay observed two lines in the night sky at 4422 and 4171 which are probably identical with Rayleigh's line. The Vegard-Kaplan bands (2,14) and (3,14) lie at 4423 and 4170 respectively. Dufay also observed lines at 4268, 4044, 3984 and 3951. Vegard-Kaplan bands nearest to these lines lie at 4271, 4043, 3978 and 3947 These agreements, together with the above mentioned experimental results, indicate that we have definitely identified some of the radiation in the night sky

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[1] Kaplan, *Phys Rev*, 33, 154, 1929
[2] Kaplan, NATURE, 133, 331, 1934
[3] Hamada, NATURE, 134, 851, 1934

Zero Point Energy and Physical Properties of H_2O and D_2O

THE marked differences between the physical properties of H_2O and D_2O (and of all polar compounds of H and D) cannot be due to intramolecular differences, which are far too small, but must be connected with differences of effective intermolecular forces It is possible to account for these differences in a quantitative way by taking into consideration the differences in the frequency of angular vibration or *libration* of a molecule in the field of its neighbours The mean frequency in ice can be calculated from the model of the water molecule already put forward[1] The frequency found, $\nu_B = 14 \cdot 3 \times 10^{12}$ sec.$^{-1}$, is large enough to have a zero point energy of 17 per cent of the total energy of ice. As in such a libration only the hydrogens are effectively in motion, it is decreased by the factor $\sqrt{2}$ on substituting D for H Apart from less important changes due to symmetry conditions and the differences in the nuclear spins, this change of frequency accounts for the greater part of the difference of energy content and specific heats of H_2O and D_2O Thus the differences of the heats of evaporation of D_2O and H_2O ices at the melting points is calculated 0 35, as against the observed value[1] of 0 32 k. cal per mol This may be regarded as the best check of the essential correctness of the theory The difference of the specific heats of ice are calculated as 0 7 and observed[2] c 1 cal per mol degree

In water ν_B must clearly have a lower value than in ice, from which it follows that the molecular latent heat of fusion of D_2O ice must be greater than for H_2O ice This is also in agreement with experiment. Besides the librations, the water molecules undergo normal vibrations but of lower frequency $\nu_A = 5 \times 10^{12}$ sec^{-1} and far less affected by the substitution of D for H Using the frequencies ν_A and ν_B it is possible to calculate the specific heat of ice At the melting point it is 9 35 as against 8 85 cal. per mol degree observed

Wave-length shifts corresponding to $\nu_A = 4\ 6-6{\cdot}7$, $\nu_B = 15 \times 10^{12}$ sec^{-1} have been observed in the Raman spectra of water by Magat[4] in reasonable agreement with the values derived by calculation from the model

Corresponding energy differences may be expected to occur in the solid or liquid state of all hydrogen compounds which possess polar properties The difference in the energies of H and D hydroxyls will depend on the temperature and the vibration frequency and hence on the field in which the hydroxy group is placed. The stronger the binding the greater the difference. Hence this difference will increase as we pass from the amphoteric hydroxyl bond to that of the alcohols and from them to the hydrogen bond of acids. Similarly, in the hydration of ions the difference will depend on the relative hydration energy and will be accordingly greater for strongly polarising ions A study of the physical properties of D compounds cannot fail to throw light on the structure of the corresponding H compound and may prove a powerful method for discovering the principles of structure of molecular solids and liquids.

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[1] J. D Bernal and R H Fowler *J Chem Phys*, 1, 515 1933, and *Proc Roy Soc*, A, 114 1, 1934

[2] G N Lewis, *J Amer Chem Soc*, **55**, 3057, 1933 V K La Mer and W N Baker, *ibid*, **56**, 2641, 1934, and L Jacobs (private communication)

[3] L Jacobs (private communication)

[4] Magat, *J de Phys*, **5**, 347, 1934

The Pair Bond Theory of Valency

THE method of molecular orbitals (Hund, Mulliken, Lennard-Jones), which is especially designed for the description of a completed molecule can be worked out in high approximations only in the simplest cases In more complicated ones, it is therefore not able to describe the process of dissociation, which is clearly the essential requirement of a theory of valency Accordingly it is necessary to resort to the correlation table which, however, gives only qualitative results, and no information regarding the quantitative loss or gain of energy. An additional assumption is therefore necessary, and this is found in the hypothesis that bonding power is always ascribed to the lowest one of a group of terms, resulting from the same atomic term by splitting due to the removal of a degeneracy The wave-function of this term in the case of one electron linking the two cores A and B is

$$a\psi_A + b\psi_B \qquad (1)$$

and

$$\{a\psi_A(1) + b\psi_B(1)\}\,\{a\psi_A(2) + b\psi_B(2)\} \qquad (2)$$

in the case of two electrons The wave-function (1) shows that a linkage can be brought about by a single electron only if the atomic fields in question are either equal ($a = b$) or almost equal ($a \approx b$), and this is why the method of molecular orbitals has recently been interpreted as leading to a single-electron bond theory When the degeneracy of the fields gradually disappears, function (1) becomes, however, simply ψ_A or ψ_B, whichever is lower, showing that the bonding power ceases when the difference between the eigen-values of ψ_A and ψ_B is no longer negligible

In our opinion, therefore, the degeneracy of (1) is not sufficient to be used as a foundation of a theory of valency, because the condition of approximate degeneracy is not satisfied in most practical cases, for example, in CO for the two p electrons introduced first into the field composed of C^{4+} and O^{4+}. Even in the case of exactly equal cores (except protons) the degeneracy is apparently too weak to bring about an actual chemical union by overcoming the repulsion of the cores (existence of Li_2, but non-existence of Li_2^+, etc) It does not seem possible to reduce, as viewpoint (1) does, the linkage to a phenomenon of non-promotion of the single electron and to consider the interaction of several electrons on the same orbital as more or less negligible

The interaction of the electrons, however, leads us to wave-functions of the type (2) with pairs of electrons on the same molecular orbital The degeneracy due to the equality of the electrons is always rigorous and remains so, even if the degeneracy of the fields disappears completely ($a \gg b$ or $b \gg a$), that is, when the molecular orbital gradually changes into an atomic orbital, or in other words, the bond changes from covalency to electrovalency. This view, that the effect of degeneracy of the electrons predominates over the effect of degeneracy of the nuclear fields, leads to an interpretation of the orbital method as a pair bond theory of valency, without resorting to strict localisation of the bonds It is our intention to show that this can be developed in detail

Mathematically this second view is fully equivalent to the first, and it does not require the additional assumption of the preservation of approximate degeneracy for unequal fields. As either interpretation is based on a hypothesis, a decision between them is possible only by comparing their consequences with the experimental evidence, and the spectroscopical data on the dissociation of molecules, especially such as NO, BeO, CaF, etc., and CO_2 appears to be in better agreement with a pair bond theory of valency. A critical analysis of chemical data, which in the light of this view has already been described[1], indicates that the experimental evidence is in better agreement with a uniform pair bond theory than with a single-electron bond theory of valency. A full report will be given elsewhere

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[1] R F Hunter and R Samuel, *J Chem Soc*, 1180, 1934

Reafforestation of Forest Trees in Great Britain

SEVERAL letters and articles have recently appeared in the public Press directing attention to the necessity for the reafforestation of the hardwood trees of Great Britain

The Forestry Commission appointed shortly after the War for the purpose of replacing the losses resulting from the excessive war demand for home grown timber, has now had about fifteen years of steady work. The Commissioners were empowered to purchase land, and plant woodlands throughout the country; but their efforts have been confined mostly to the planting of softwoods, and with the exception of some limited areas there has been little or no planting of hardwood trees.

It is not generally realised that for quite a considerable time before the War, and during the years which have passed since, vast quantities of trees of oak, and ash, beech, walnut, etc. have been hewn down and gone into consumption. The destruction has proceeded on a scale far beyond anything which occurred during the previous hundred years, and now gradually every tree which is realisable has to come down, including every kind which possesses a monetary value, whether of mature growth or wholly immature. The tragic condition is particularly noticeable throughout Sussex, a county which was formerly one of our most beautifully wooded and richest in hardwoods.

Anyone who has travelled over long distances in India, America, and other parts of the earth, has seen areas which thoughtless men have denuded of all trees and are now barren wastes We are bringing about the same condition in England, and Sussex is by no means the only county which has suffered. As a writer has said: "Wherever man has settled the forests disappear. Up till now the march of civilisation has everywhere proclaimed the destruction of trees over the wide surface of the globe"

In 1925 I read a paper on this subject at the meeting of the British Association at Southampton, and again each year excepting one at the subsequent meetings until that in London in 1931; but the public is still quite unaware of the true state of affairs It is not realised that the once beautifully timbered parks and woodlands throughout the country are being completely wiped out.

Great Britain has been famous all over the world for the beauty and wealth of her woodlands, and because of the planting done by our landowners we were able before the War to boast of a fully sufficient reserve of valuable timber. The "march of civilisation" has overtaken us, and unless something is done there will be no escape from a deplorable result. The Irish Free State has handled this situation, and under the Forestry Act of 1928 made very stringent orders for the protection of its woodlands Application has to be made to the Department of Lands, Forestry Division, Dublin, and permits must be obtained by "*any* person who wishes to fell *any* tree on his holding", and licences may contain stipulations for replacement In England, Scotland and Wales, thousands of hardwood trees have been cut down and practically nothing planted; in southern Europe for every tree that is allowed to be felled hundreds are planted There must surely be something seriously wrong with us if we allow this state of affairs to continue

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Interpretation of Animal Behaviour

IN a recent article on the "Interpretation of Animal Behaviour"[1] the view was advanced that a preoccupation with teleological explanations was necessarily somewhat unscientific and philosophical

Since the future development of psychology—and probably of biology—will depend largely on whether men of science agree to recognise the validity of purposive concepts or decide to consider them as being inadmissible, the question is of great importance Already, the nature and content of the problems investigated depend largely on what the investigators concerned *think on this point*

It is generally agreed, of course, that science necessarily operates in a world of objective fact and that it must be deterministic But it is unwise to assume that vitalistic theories or teleological interpretations are less scientific and deterministic, or more metaphysical, than are mechanical theories using efficient causation After all, the *facts* alone can be considered objective and *all* modes of interpretation or of analysis of them are, in a sense, subjective.

Again, the doctrines of efficient and of final causation are both philosophical in so far as they are merely principles of explanation not themselves contained in the facts studied Nor can it be maintained *that preoccupation with teleology is necessarily* unscientific In fact, the principal claim of the vitalist school is that the category of final causation is a legitimate weapon of *scientific* analysis, capable of being applied rigidly to particular problems It is difficult to understand why unfortunate teleologists should necessarily be relegated to the same scrapheap *as the universally despised metaphysicians!*

Both the believers in efficient causation and the teleologists agree on one point: the present moment is not understandable in isolation Mechanists insist that the past is immanent in the present, teleologists insist that the future is equally immanent in the present. Clearly both are justified in their beliefs, but why should the latter alone be condemned as unscientific anthropomorphs?

If I may paraphrase Prof. A N. Whitehead, is it not true to say that those psychologists who are animated by the purpose of showing that neither they themselves nor the animals have purposes, form an interesting subject for psychological investigation?

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Jan. 16.

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[1] NATURE, 134, 996, Dec. 29, 1934

I AM afraid I neither realise the basis nor appreciate the strength of Mr. Lauwerys' clearly implied prophecy that fruitful developments of biology and psychology—by which I trust he means the study of behaviour, since that is the matter under discussion—depend largely on the acceptance of teleological ideas in general, and the concept of purpose in particular. The issues as they are stated are unfortunately vague, and difficult to discuss in a short space, but if prophecies in these matters are of any value, it seems to me that the futures of these subjects depend only upon the further recognition of sensible problems, capable of investigation, within the fields of objective fact to which they refer. The criterion of objective fact, from the point of view of science, is that it constitutes a datum that is public in the sense defined by Hogben, and is capable of expression without fear of ambiguity.

The methods by which facts such as these may be analysed can be many and varied, provided they conform to the demands of proper scientific procedure. Since it is perfectly legitimate to regard 'explaining' in science as being synonymous with generalising and hypothesising, it seems to me idle to contend that in science 'interpretations' and 'explanations' are any more subjective than the primary data to which they relate. In this connexion it is well to remember that both opponents and protagonists of classical behaviourism agree that this school of psychology breaks down as a final philosophy because of its indefensible but necessary assumption that the objective facts of experience are unrelated to subjective experience. But in any event the whole question raised by Mr. Lauwerys is completely irrelevant. Determinism, if need be, could flourish in the thickest undergrowths of a solipsist's mind.

Mr. Lauwerys states that it is the teleologist who insists that the future is immanent in the present. In so far as the merits of a deterministic hypothesis are weighed by its value for purposes of prediction, this, by definition, is also part of the determinist's creed. Mr. Lauwerys is simply making a false antithesis. Merely agreeing that the prediction of the future is a worthy aim of science does not give to teleology any virtue that makes it necessary in scientific research.

I am not prepared to say whether or not the category of final causation is a weapon of scientific analysis. If it is, Mr. Lauwerys and those who agree with him have the task of showing that it can operate as such. At the moment, those who conduct their investigations according to everyday deterministic methods, without any appeals to teleology, are doing most, if not all, of the work of extending our reliable knowledge of phenomena.

THE WRITER OF THE ARTICLE

Effect of Ultra-Centrifuging on the Cells of the Root-Tip of the Bean

ROOT-TIPS of the bean were centrifuged in the Beams ultra-centrifuge at approximately 400,000 times gravity for twenty minutes. The effect is shown diagrammatically in Fig. 1. Fig. 1(*a*) is a control cell showing the normal distribution of the cytoplasmic components and inclusions. Fig. 1(*b*) represents an ultra-centrifuged cell showing the redistribution of the cytoplasmic components and inclusions into layers in the order of their relative and decreasing specific gravity, as follows: (1) a layer of starch grains and plastids (when present in the cell); (2) a layer of mitochondria (plastidome and pseudo-chondriome), (3) a layer of cytoplasm (which is often quite free of various cytoplasmic components); (4) a layer of osmiophilic platelets (Golgi bodies of Bowen), (5) a layer composed of, or formed by, the fusion of vacuoles and (6) a layer of lipoid material. Thus, it is evident from this study that the osmiophilic platelets are discrete structures in plant cytoplasm, and differ greatly in specific gravity from the plastids and mitochondria.

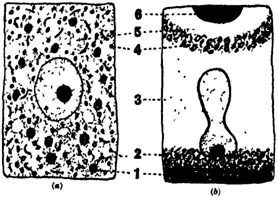

FIG. 1

The nucleus is frequently stretched in the direction of the centrifugal force with the nucleolus constituting its heaviest component. In extreme cases, the nucleolus is thrown completely out of the nucleus centrifugally.

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Some Recent Atomic Weight Determinations

IN conjunction with Mr. H. S. Patterson, a number of new determinations of the limiting ratios of certain gases with oxygen have been carried out, using an improved microbalance apparatus in which errors due to adsorption have been eliminated. A more detailed account of the apparatus and results will be published elsewhere.

The gases used were nitrous oxide, ethylene, carbon dioxide and carbon tetrafluoride. The measurements obtained from these gases lead to the following values of the atomic weights:

$$N_{\mathrm{N_2O}} = 14{\cdot}006(8). \quad C_{\mathrm{C_2H_4}} = 12{\cdot}012(2)$$
$$C_{\mathrm{CO_2}} = 12{\cdot}010(1). \quad F_{\mathrm{CF_4}} = 18{\cdot}995.$$

The compressibilities at 21° C. of the gases can be calculated from the data and are appended below in comparison with the values obtained on an Andrew's compression apparatus[1].

Gas	$A_{21^\circ\mathrm{C}}$ microbalance	$A_{21^\circ\mathrm{C}}$ Andrew's apparatus
Nitrous oxide	0·00559	0·00567
Ethylene	0·00636	0·00612
Carbon dioxide	0·00522	0·00526
Carbon tetrafluoride	0·00418	0·00420

Whilst the values of nitrogen and fluorine are in close agreement with the accepted values, carbon is distinctly higher than the accepted $C = 12{\cdot}00$ Nevertheless, this high result, which indicates about one per cent of the 13 isotope, is in agreement with the spectroscopic work of Jenkins and Ornstein[2], and the value of $C = 12{\cdot}011$ of Woodhead and Whytlaw-Gray[3] Indeed, the agreement between our values from two entirely different gases and those of the other workers is so close that it seems very improbable that they are in error, and consequently that the true atomic weight of carbon is 12 01

The value of $F = 18\ 995$ does not agree with the preliminary value of $F = 19\ 01$ which we published in these columns[4], using methyl fluoride Consequently, these measurements have recently been repeated with the new apparatus The new data lead to an atomic weight of $F = 18\ 995$ and a compressibility of $A_{21°C} = 0\ 0090$ As would be expected, the adsorption error does not affect the compressibility to any marked extent This last figure is in agreement with $A_{21°C} = 0\ 0088$, measured on the Andrew's apparatus It leads to $A_{0°C} = 0\ 0117$, which does not confirm the value of Moles and Batuecas[5] Consequently, our previous criticisms[6] still hold good

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[1] Cawood and Patterson, *J Chem Soc*, 156, 619, 1933
[2] *Proc K Acad Wetench Amsterdam*, **33**, 1212, 1932
[3] *J Chem Soc*, 209, 846, 1933
[4] Patterson and Cawood, NATURE, **128**, 375, 1931
[5] *J Chim Phys*, **18**, 353, 1920
[6] Patterson and Cawood, NATURE, **129**, 245, 1932.

Effect of Temperature on the Absorption of Crystals in the Infra-Red

IN a recent publication, Matossi and his collaborators[1] have investigated experimentally the influence of temperature on the absorption of crystals in the infra-red, this is to some degree an extension of the classical work of Rubens and Hertz[2].

A rather interesting point raised is that the fundamental feature of the earlier work—the distinction between regions sensitive and insensitive to temperature—may be spurious, and due to the shift with temperature of the band as a whole

It is possible to say, however, that the distinction drawn by Rubens and Hertz does exist, though not in the form suggested by these investigators—that the 'inner' vibrations are the insensitive, and 'outer' vibrations the sensitive ones The theory of the damping of the infra red vibrations[3] shows that this is due to the coupling between the main vibrations and combinations of two other normal vibrations, and, further, that (*a*) the absorption on the short wave-length of the main vibration (λ_0) up to a point roughly $\lambda_0/\sqrt{2}$, is due to summation tones, and (*b*) the absorption on the long wave-length side is due to difference tones

In the language of the quantum theory, the summation tones are produced by jumps from lower to higher quantum levels, whereas in a difference tone one of the jumps is from an excited to a lower level. It is obvious that, at very low temperatures, very few oscillators are in an excited state, hence the absorption due to difference tones must decrease to zero as the temperature decreases to zero.

It is also clear that absorption due to summation tones must be relatively insensitive to temperature, since at very low temperatures, where most oscillators are in the ground state, we can still have jumps from the ground state to excited states

Hence the absorption on the short wave-length side of the main vibration should be relatively insensitive, that on the long wave length side sensitive, to temperature The distinction is obviously of the same kind as between the Stokes and anti-Stokes lines in the Raman effect[4]

There is unfortunately no experimental data in the region between λ_0 and $\lambda_0\sqrt{2}$, where one would expect the really interesting effects, it is to be hoped that experimenters will investigate this region as well as the other regions

A more detailed treatment of the absorption in the infra-red will be given in a forthcoming paper

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[1] F Matossi and H Brix, *Z Phys*, **92**, 303, 1934 F Matossi and H Kindler, *Z Phys*, **92**, 312, 1934
[2] H Rubens and G Hertz, *Berlin Ber*, 256, 1912
[3] M Born and M Blackman, *Z Phys*, **82**, 551 1933 M Blackman, *Z Phys*, **86**, 421, 1933 See also W Pauli, *Verh d D Phys*, 6, 10, 1925
[4] A Smekal, *Naturw*, **11**, 873, 1923

Surface Tension of Urine during the Menstrual Cycle

WE have recently carried out in this laboratory surface tension measurements in connexion with the excretion of capillary-active substances in the urine of the normal human female Over a period of twenty-eight days the surface tension of the first morning specimen each day was determined, and the centrifuged deposit examined microscopically for blood corpuscles, so that the onset of menstruation could be ascertained as early as possible. A typical curve of the variation is shown in Fig 1, and from this the following interesting observations can be made

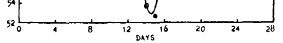

FIG. 1.

The curve consists of four phases corresponding in temporal relation to the four divisions into which—on physiological evidence—the human period can be divided, namely, resting, constructive, destructive and repair stages.

As regards the length and rhythm of cycle, it appears that the measurement of surface tension possibly provides a new means of estimating these hitherto inaccessible factors. For example, the curve shown is one of a cycle of length 25 days and of normal rhythm.

At the loop *A* on the diagram where one cycle ends and the next commences, the surface tension attains a maximum value and capillary activity is at a minimum This corresponds in time to that period where, according to recent physiological investigations, ovulation probably occurs[1].

As regards the nature of the substances causing this variation of surface tension, we can at present say nothing definite It is known, however, that certain hormonic activities, such as excretion of prolan *A* near the midpoint of the cycle[2], are of a periodic nature, and it is, we think, legitimate to suggest that these causative substances are at least linked with the hormones responsible for the menstrual cycle

Further work is being carried out on these and kindred problems, a full account of which will be published shortly

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[1] "Periodic Fertility and Sterility in Women", H Knaus Vienna, 1934

[2] R Kurzrok, I J Kirkman and M Creelman, *Amer J Obst and Gyn*, Sept 1934

Biological Formation of Ascorbic Acid

WE have already reported[1] that the spleen, kidney and liver tissues of the rat are able to form significant amounts of ascorbic acid, as determined titrimetrically, when incubated with mannose for three hours at *p*H 7·4 at 37° The brain, heart-muscle and leg muscle tissues of the rat have also been found to share this power, though to a less extent It has been possible, further, to extract the mannose dehydrogenase system from the spleen, kidney and liver tissues of the rat[2] A similar enzyme system has also been extracted from germinating *mung* (*Phaseolus mungo*), which can convert mannose into ascorbic acid at *p*H 5 8, but not at *p*H 7 4 This is perhaps related to the acidity of the germinating *mung*.

The ability with which the isolated tissues convert mannose into ascorbic acid *in vitro* differs considerably according to the species, as will be observed from the following table, which gives results obtained with liver tissue only

Species	Ascorbic Acid (mgm) formed per gm liver tissue after incubation with mannose for 3 hours at *p*H 7 4 at 37°
Rat	+0 300
Rabbit	+0 040
Pigeon	+0 053
Guinea pig (normal)	-0 030
Guinea pig (scorbutic)	−0 020
Monkey	−0 010

It will be noticed that the liver tissues of the rat, rabbit and pigeon—species known to be independent of an external source of vitamin C—are able to form ascorbic acid from mannose, whereas the liver tissues of the guinea pig, both normal and scorbutic, and monkey, which are dependent on an outside supply of vitamin C, are apparently unable to do so

It has generally been found that the other sugars studied, glucose, fructose, galactose, rhamnose, xylose and arabinose, are converted into ascorbic acid by the tissues of none of these animals under our conditions of experiment, with the exception that the liver tissue of the pigeon can convert glucose into ascorbic acid (0·033 mgm. ascorbic acid being formed per gm of the tissue). Preliminary experiments indicate the possibility that prolonged incubation of glucose with the liver tissue of the rat may also produce ascorbic acid

It is necessary to state that, in the absence of biological tests, which are presenting several technical difficulties, this work involves the assumption that the substance titrating with 2 6-dichlorophenol indophenol consists solely of vitamin C

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[1] Guha and Ghosh, NATURE, 134, 739 , 1934

[2] Guha and Ghosh, *Current Science*, 3, 251 , 1934

Alleged Œstrogenic Activity of the Male Sex Hormone

CORRELATION of molecular structure of the sex hormones with that of the sterols and bile acids is now almost complete, and leads to the conclusion that the hormones are biological degradation products of cholesterol Adopting the working hypothesis that the male hormone (androsterone) is the immediate precursor of the female hormone (œstrone), a study of the action of various tissue extracts on androsterone has been commenced in the hope of converting this hormone into œstrone by biochemical means. The œstrus test gives a very sensitive method of detecting any such conversion.

The œstrogenic action of various testicular extracts[1] and male hormone extracts prepared from urine (for example, hombreol) has led to the suggestion that the male hormone has the same effect on the female genital tract as the female hormone[2]. If this were true, then of course the biological test would be valueless as a means of detecting dehydrogenation of the androsterone molecule. However, it is certain that the œstrogenic activity of male hormone preparations is due to the presence of substances other than this hormone, for no œstrogenic activity could be detected with pure crystalline androsterone prepared from cholesterol by the method of Ruzicka[3]

Four injections of 0·25 mgm. of androsterone, dissolved in sesame oil, were made into each of five ovariectomised mice at 12-hour intervals Vaginal smears were examined during 72 hours following the last injection, and showed no sign of œstrus These mice were afterwards given four injections of 0·25 γ of œstrone, and then showed a full œstrous response Two other castrated female mice received a total of 10 mgm each of androsterone with completely negative results Post mortem examination of these two animals showed no enlargement of the uterus or any other symptoms normally associated with the action of œstrogenic substances

The androsterone used in these experiments was generously presented by Ciba, Ltd , at the request of Prof Ruzicka

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[1] Brouha and Simonnet, *C R. Soc Biol*, 99, 41 , 1928

[2] St Skowron and E Turyna, *Pol Gaz Lek.*, Nr. 18 , 1934. St Skowron, NATURE, 134, 627 , 1934

[3] Ruzicka, Goldberg, Meyer, Brüngger and Eichenberger, *Helv. Chim Acta*, 17, 1395 , 1934

Mr. Mallock's Electrical Calculating Machine

READERS of NATURE may be interested in some details from my own experience of the electrical calculating machine invented by Mr. R. R. M. Mallock, constructed by the Cambridge Instrument Company, and mentioned in the issue of January 12, p. 63.

Through the kindness of Mr. Mallock and the hospitality of Mr. C. C. Mason, of Cambridge, I was privileged for a few days in October 1933 to see the machine at work. Being a little sceptical, I had provided myself beforehand with certain problems, for some of which I had solutions. I first proposed the solution of six simultaneous equations (coefficients all to 3 decimals), knowing the answers to be

0·866, – 0·415, 0·173, 0·337, – 0·126, 0·079

Under Mr. Mallock's direction I set up the coefficients on the switchboard while he connected the plugs. First approximations were quickly read off as 0·8711, – 0·4046, 0·1866, 0·3493, – 0·1246, 0·0659. Refinements gave in a few minutes the satisfactory results

0·8650, – 0·4149, 0·1722, 0·3370, – 0·1258, 0·0794

Much of the time was taken up by questions and explanations, but I note from my records the total time as "11.48 a.m. to 12.26 p.m., 6/10/33". This very short time could have been greatly reduced.

On other occasions I observed the machine perform, to my proposals, the solution of algebraic equations, of characteristic equations of matrices (latent roots), the evaluation of determinants and of quadratic forms in several variables in specified regions, and cognate problems. It seems to me that in this realm, which is one of wide physical and statistical application, the machine has remarkable potentialities, and one hopes that its merits will gain it not merely the publicity, but also the opportunity for practical service which it awaits.

Mathematical Institute,
University,
Edinburgh.
Jan. 22.

A. C. AITKEN

Points from Foregoing Letters

THE origin of the light of the aurora and of the night sky has been much debated. Prof. J. Kaplan states that he has succeeded in obtaining in the laboratory the green line λ5577, identical with that present both in the aurora and the light of the night sky. This he has done by means of a rapidly interrupted electrical discharge through nitrogen gas containing 1 per cent oxygen. The light emitted contained also other bands (Vegard-Kaplan system) which probably occur in the night sky.

Heavy and ordinary water differ in many of their chemical properties more than would be expected from the extra weight of the hydrogen atom present in the heavy variety. Mr. J. D. Bernal and Mr. G. Tamm ascribe these differences to the angular vibration (libration) of the molecules. Having calculated the energy associated with such libration, they find that it accounts for differences in the specific heat, and heats of evaporation and fusion of H_2O and D_2O, and also for the wave-length shift in the spectrum of light scattered by water.

By centrifuging the cells of the root tips of the bean, Dr. H. W. Beams and Mr. R. L. King note that various cell constituents arrange themselves in layers according to their specific gravity. They submit diagrams showing, among other things, that the Golgi bodies (platelets coloured black by osmium reagent) are in this way separated from the mitochondria (protoplasmic rods and granules), from which they cannot otherwise be readily distinguished.

From the density of several gaseous compounds of carbon (CO_2, C_2H_4, CF_4) compared with that of oxygen by means of a micro balance, Dr. W. Cawood concludes that 12·01 is a more exact value for the atomic weight of carbon, which would indicate the presence of about 1 per cent of the ^{13}C isotope. The compressibilities of those gases, based upon the newly calculated atomic weight, agree with those experimentally determined. For the atomic weights of nitrogen and fluorine, determined in the same way, the values 14·006 and 18·995 are given.

Dr. Blackman discusses in the light of the quantum theory whether, in the infra-red absorption spectrum of crystals, one should expect certain regions to be insensitive to temperature changes, as was experimentally stated to be the case by Rubens and Hertz. He concludes that the absorption on the short wave-length side of the main vibration should be less sensitive than that on the long wave-length side and appeals for further experimental work in this field.

Messrs. C. F. Selous and P. W. Perryman give a graph showing how the surface tension of urine varies during the menstrual cycle. It has a maximum value at the time when ovulation probably occurs and a minimum during menstruation, due possibly to the presence of hormones such as prolan A, the hormone stimulating the growth of the follicle containing the ova.

Dr. B. C. Guha and Mr. A. R. Ghosh report that not only the spleen, kidney and liver but also the brain and heart and leg muscle tissues of the rat have apparently the power of producing vitamin C (ascorbic acid) from the sugar-like substance mannose. They further find that the liver tissues of only those animals which are known to be independent of outside supplies of vitamin C can bring about the conversion of mannose into ascorbic acid. They have hitherto relied upon a chemical method of estimating the quantity of vitamin C produced.

Male hormone (androsterone) prepared from cholesterol (a common wax-like substance present in wool-fat, blood, etc.) has no effect upon the female genital tract according to Mr. F. L. Warren. This shows that the results obtained by previous investigators, who have reported that testicular extracts have the same effect on the female genital tract as the female hormone, must be due to some other substance present in those extracts. Mr. Warren suggests that the male hormone may be the immediate precursor of the female hormone and hopes to convert one into the other by biochemical means.

Research Items

Race and Constitutional Types. Studies of human morphological (constitutional) types have been made in accordance with a variety of methods, depending for the most part on inspection rather than measurement, with the object of determining the character and frequency of such types within a given population. It has been suggested, further, that the morphological type correlates with functional and psychic type to make a 'bio-type', and also with race Thus in a study of the population of Germany, it has been found that, of Kretschmer's three types, the leptosome corresponds to the Nordic, the athletic to the Dinaric and the pycnic to the Mediterranean and the Alpine An additional character would, therefore, appear to be afforded for racial classification This method of analysis, however, hitherto has been applied only to Europeans With the view of determining its value to the anthropologist, it has now been applied to natives of Indo China and Madagascar by Dr G Machado da Sousa (*L'Anthropologie*, **44**, No 5–6) It would appear that the classification based upon European material does not hold good when applied to other races, the combination of characters of which the types are composed being different, while of the methods employed two only, those of Viola and of Manourvrier, were found suitable It appears, however, that among the natives of Indo China there is no correspondence in the types obtained by the two methods As regards characters, among the Indo-Chinese, cranial form and morphological type do not correspond, but, on the other hand, there is a certain relation between the type and the form of the face. Generally, there would appear to be no correlation between racial type and constitutional type, though it is possible in the two races under consideration to recognise two extreme types of individual morphology

Problem of Immunity in Cancer. Dr M J A des Ligneris has recently described researches carried out to investigate whether the serum of animals treated by injections of cancerous tissues acquire specific antibodies to malignant cells (*Pub South African Inst Med Res*, No. 34 "Studies on Cell Growth (2) The Growth *in vitro* of Normal Mouse Cells and of Mouse Cancer Cells (Carcinoma, Sarcoma) in Neutral and Immune Media (Serum plasma)") Dr des Ligneris inoculated two sheep eight times each, at intervals of 8–10 days, with crushed mouse carcinoma (63 of the Imperial Cancer Research Fund), and two similar sheep at the same times with crushed normal organs of healthy mice Fragments of normal mouse organs (spleen, lungs, liver and kidney), of mouse carcinoma 63, and of mouse sarcoma 37 were grown in tissue cultures, employing sera and plasma obtained from normal rats, fowls, rabbits and sheep Upon these cultures was tested the action of sera and plasma from the inoculated sheep. Of the results of these experiments Dr des Ligneris says that they "clearly show that, in the serum of sheep treated with repeated injections of mouse carcinoma tissue, the developing antibodies have, for all practical purposes, none other than anti-species characters, it was not possible to detect in these sheep sera any kind of antibody capable of showing any specifically 'anti-malignant' characteristics"

Early Development of the Ferret W J Hamilton describes (*Trans Roy. Soc. Edin*, 58, 251 278 ; 1934) the early development of the ferret, based on the examination of living and of fixed material The egg is richly supplied with fat in the form of globules. At one pole of the egg is a cytoplasmic crescent, covering about one half of the egg, and here the fat globules are less densely present In life, the zona pellucida appears as a homogeneous membrane, surrounding the perivitelline space in which the egg can rotate. The first cleavage produces two cells similar in appearance but not equal in size, and their next division is *not* synchronous, hence a *three-cell* stage is produced In the four cell stage the cells are usually arranged in the form of a cross, and one of the cells was found to be smaller than the other three. At the sixteen cell stage one *cell* is centrally placed ; it has the same morphological characters as the other cells and the fat is equally distributed among the cells A little later a cavity – the blastocœl —arises as an intercellular space or by the fusion of intercellular spaces. The blastocyst increases very rapidly in size, the trophoblast becomes attenuated and the inner cell mass (produced by the division of the central cell of the sixteen-cell stage) becomes lenticular and later forms the embryonic disc The central cell mass is attached at one point to the trophoblast and the disappearance of the covering trophoblast takes place relatively early in the ferret Endoderm cells arise from the convex surface of the disc as a continuous layer, they are at first flattened but later, *under the anterior part of the embryonic* disc, they become columnar, forming the prochordal plate Fat is found in the embryonic ectoderm and in the trophoblast, but not in the endoderm cells The paper is illustrated by eighty photomicrographs.

Insects and Spiders from East Greenland. In the *Annals and Magazine of Natural History* of December, Mr David Lack contributes a short account of some insects obtained by the Cambridge expedition to Scoresby Sound in lat. 70° N Most of the collection was made around Hurry Inlet, a subsidiary fjord running north from Scoresby Sound, on August 1–15 The list given by Mr Lack includes all the orders of insects collected, excepting the Diptera which are not yet identified, and various specialists are responsible for the names given. Of the eight species of Collembola recorded, four are new to Greenland one species of Lepidoptera is new to science and one other species, together with a single species of Aphididæ, have not been previously recorded from Greenland. Two other species of Lepidoptera, it may be added, are new to east Greenland, but were previously known from west Greenland All the other species listed were already known from east Greenland. The present collection emphasises the poorness of the insect fauna of east as compared with west Greenland The Ichneumonids collected by the expedition form the subject of a separate paper by Mr. M A Roman, of Stockholm, in the same issue of the journal They are represented by eleven species, of which one, and the female of another species, are new to science. A third paper by Mr. A. Randell Jackson deals with the spiders, of which there are thirteen species. Among these latter, five appear to have been previously unrecorded from

Greenland, including one new species. The general conclusion is that, so far as is at present known, the spider fauna of Greenland is mainly American, which may be contrasted with that of Iceland, which is mainly European.

Fossil Starfishes. The *Proceedings of the Royal Society of Victoria*, **46** (New Series), Part 2, May 1934, contains two interesting papers on fossil star fishes: "A Lower Cretaceous Brittle-star from Queensland" by Frederick Chapman, and "The Palæozoic Starfish of Victoria" by Robert B. Withers and R. A. Keble. The brittle-star is a new species of *Ophiacantha*, *O. (Ophioglyphoida) fosteri*, found on the fractured faces of a bore-core obtained at Cleeve, near Longreach, Queensland. The Asteroidea are dealt with in the second paper. There are now fifteen recognisable species known from Victoria, of which ten are new. They are all from the Silurian, and are distributed over eight genera; *Hudsonaster*, *Caractacaster*, *Promopalæaster* and *Petraster* are restricted to the Ordovician in England and America; *Urasterella*, *Salteraster* and *Schuchertia* begin in the Ordovician, but range into the Silurian. *Palasterina* alone of the eight genera does not occur elsewhere lower than the Silurian. As the authors state, "this would seem to indicate that asterid distribution started from a point in the Northern Hemisphere".

Cytological Studies in Pears. In a recent paper (*J. Pomol. and Hort. Sci.*, **12**, No. 4, pp. 321–326, December, 1934), Mr. A. A. Moffett, of the John Innes Horticultural Institution, reports an interesting study of the cytology of thirty-four varieties of pear. Chromosome numbers of these varieties have been determined. Twenty-seven diploids, each with 34 chromosomes, and seven triploids, with 51 chromosomes, have been found. The triploids are relatively infertile, and, apart from the variety Pitmaston Duchess, are not cultivated extensively. This is partly due to the unequal reduction of the triploid at the formation of gametes; but the paper under review shows that there is a marked difference in the vigour of the pollen. Pollen from a diploid plant usually germinates readily, the greater number of varieties having a pollen germination of more than 50 per cent, while pollen from a triploid rarely attains more than 25 per cent germination.

Temperature and Humidity near the Ground in India. In a paper on micro-climatology by L. A. Ramdas, which appeared in *Current Science* of May 1934, reference is made to some interesting facts concerning the diurnal variation of the air temperature and the pressure of aqueous vapour in the first few feet above the ground. In temperate latitudes, as is well known, the surface turbulence set up by solar radiation during the day tends to die out completely on clear windless nights, when the air becomes stratified and the lowest temperature is to be found on the ground itself. Judging from the results obtained at Poona, this is not generally the case within the tropics, even in winter, for the accumulated solar heat there is great enough to maintain a layer of turbulence all through the night, although a very shallow one compared with the layer at its maximum development in the afternoon. An unexpected result was also obtained in connexion with the pressure of aqueous vapour, which showed a minimum close to the ground at night in the autumn, although in sunny weather evaporation from the ground tended to give a maximum near the ground, as was to be expected. The explanation was apparent when measurements were made of the water content of samples of surface soil exposed under natural conditions; it appears that the surface soil became sufficiently desiccated by evening in the autumn to become an absorber of water vapour at night, and that this was the cause of the night minimum close to the ground. The two phenomena together resulted in the layer of deposition of dew beginning at some height between six and twelve inches, and in an increase of the amount with height above the ground.

Isotopic Ratio of Oxygen and the Atomic Weight of Hydrogen. It has been pointed out that in the paragraph appearing under the above heading in NATURE of December 22, p. 977, the term "atomic weight of hydrogen" was used throughout instead of "the mass of the hydrogen isotope, H^1". It may be mentioned that the research was undertaken to discover where the discrepancy between the chemical atomic weight of hydrogen (1.00777) and the mass of the hydrogen isotope, H^1 (1.00756, on the scale $O = 16$), lay. The hydrogen used for the best atomic weight determinations has been obtained electrolytically, and contains a very small proportion of the heavy isotope, H^2 ($H^1 : H^2 = 30,000 : 1$). Its atomic weight should therefore approximate closely to the mass of the hydrogen isotope, H^1. The re-determination of the isotopic ratio of oxygen gives the value 1.00763 for the mass of the isotope, H^1, which is nearer the chemical value.

Experiments with Positrons. In a paper contributed to the German Physical and Mathematical Conference at Pyrmont in September 1934 (*Phys. Z.*, **35**, 999, 1934), E. Rupp describes a number of fundamental experiments with positrons. An apparatus for the artificial production of positrons is described. Accelerated protons impinge on a layer of lithium within a hemispherical cup of aluminium foil. α-Rays emitted from the lithium strike the aluminium, and give rise to positrons. The positrons obtained had velocities varying from 800 to 1,000 kilovolts. The value of the ratio of the charge to the mass was determined by applying a magnetic and an electric field in the usual way, and was found to be identical, within the limits of experimental error, with that for electrons. An attempt was made to determine the mass of the positron by studying the diffraction of positrons at aluminium and gold foils. Assuming that the positron, like the electron, is associated with a wave-motion, it would be expected that the relationship $\lambda = h/mv$ would hold, λ being the wave length, m the mass, and v the velocity of the positron, and h Planck's constant. It was found, however, that no definite diffraction occurred, but there was a continuous scattering. The absorption of positrons by aluminium, copper and gold foils was also investigated. To a first approximation, the absorption is proportional to the atomic weight of the absorbent. The production of X-rays by bombardment of anticathodes by positrons was studied. The X rays obtained from all the substances investigated (gold, copper, silver, graphite, rock-salt and galena) were monochromatic, the wave-length being independent of the velocity of the positrons. The X-rays from all the substances examined had the same absorption coefficient, which is thus a characteristic of positrons, and not of the substance used as the anticathode.

Pittsburgh Meeting of the American Association

THE ninety-fifth meeting of the American Association for the Advancement of Science was held at Pittsburgh on December 27–January 2, and during the week members of this and associated organisations numbering nearly four thousand participated there in a most successful series of meetings Joined with the city as hosts were the Carnegie Institute of Technology, the University of Pittsburgh, the Pennsylvania College for Women, Duquesne University and the Mellon Institute Dr Thomas S Baker, president of the Carnegie Institute of Technology, was chairman of the local committee and Dr Davenport Hooker, of the University of Pittsburgh, vice-chairman Arrangements for sessions were admirably provided in the group of academic and public buildings in the Schenley Park centre

Two previous meetings have been held in Pittsburgh, both of them marked by events of especial significance in the history of the Association The first in June 1902 was the last of the fifty one summer meetings, at it was adopted a new plan for mid-winter Convocation Week meetings, bringing together a large group of scientific organisations, the first of which was held in Washington in the following December This plan, which has been followed ever since, has served well to develop scientific work and influence in the country The second Pittsburgh meeting was held in December 1917 with a programme devoted to national preparedness and effective participation in the War. It exercised an important influence on the country at this crucial period

Pittsburgh played a prominent part in early colonial history. Its strategic location and the immense value of the natural resources of the region gave support to the later initial enterprises in manufacturing lines, and led to the development of mining and other industrial activities on the immense scale that characterises this region to-day The secret of its success has been the application of science to the utilisation of natural resources. In consequence, it offers attractions to scientific organisations which were well utilised in planning and carrying out the programme of the meeting

In all, forty-two affiliated societies met in conjunction with the fifteen sections of the Association. The programmes were replete with papers of striking value, and attendance was larger than for several years past. A few of the outstanding features may be mentioned briefly

The evening general sessions were held in the Carnegie Music Hall On December 27, President Thorndike presided and responded to the addresses of welcome from the city and the universities The address was given by Dr. William A White of the U.S Public Health Service on "Man, the Great Integrator", it was illustrated by examples from the field of psychiatry showing the reciprocal relation of the world within and the world without, it demonstrated how psychiatry, like general science, has discarded many of the older traditional ways of thinking and as a result has discovered a new world of thought and knowledge of great significance to the understanding of man and to culture in general.

On December 28, Prof. E A. Hooton of Harvard delivered the Sigma Xi address on "*Homo sapiens*, Whence and Whither" On December 29, Dr. Charles F Kettering, director of General Motors Research, spoke on "Some Future Problems of Science and Engineering" On December 31 came the address of the retiring president of the Association, Dr. Henry Norris Russell of Princeton, on "The Atmospheres of the Planets" [see p. 219] The Josiah Willard Gibbs lecture was given by Prof. Albert Einstein [see NATURE, Jan. 19, p. 111]

Among special afternoon lectures was one to mark the quarter centennial of the discovery of the north pole It was given on December 27 by Prof Wm H. Hobbs of Michigan on "The Career of Admiral Peary, the Discoverer of the North Pole" Prof. H H Newman of Chicago delivered an illustrated address on December 28 on "Twins Reared Apart and the Nature Nurture Problem" On December 28 also, W R Chapline of the U S Forest Service lectured on "Forestry fosters New Approaches to Watershed Conservation", describing with sound films researches of the U S Forest Service dealing with stream-flow and erosion problems on forest and range lands On December 29, Prof M H Liddell of Purdue spoke on "The Acoustics of the Auditory Spectrum", and was assisted by Prof C T Knipp of Illinois, who demonstrated the Knipp singing tubes. On December 30, Dr Phillips Thomas of the Research Department of Westinghouse, under the title "Ramblings in Research", gave a remarkable demonstration of recent discoveries not previously presented publicly.

The American Society of Naturalists in its annual symposium dealt with "Cytogenetic Evolutionary Processes and Their Bearing on Evolution Theory". Prof A F Shull of Michigan took as the subject of the presidential address "Weismann and Haeckel: One Hundred Years".

The Committee on the Place of Science in Education presented programmes of invited papers at two sessions, and had a largely attended luncheon, after which Dr E L Thorndike, president of the Association, spoke on "Psychology of Attitudes"

Many symposia and joint sessions were arranged by various sections and affiliated societies In one, the Ecological Society of America with the Society of American Foresters included an invitation paper by Dr R. Maclagan Gorrie on "The Work of the Forest Research Institute, Dehra Dun, India", illustrated by fine moving pictures. A symposium on science and the Press was largely attended [see p. 239]

The production of active immunity against poliomyelitis was reported in papers by Dr. Maurice Brodie of New York City and by John A Kolmer of Temple University, and a series of invited papers on sulphur-containing compounds in their relation to cancer, arthritis, muscular dystrophy and cystinuria were presented in two especially important symposia in the Section of Medical Sciences.

The twelfth annual American Association prize of one thousand dollars was unanimously awarded by the committee to Dr. Vern O. Knudson of the University of California at Los Angeles, for his paper entitled "The Absorption of Sound in Gases". Dr. Knudson has cleverly adapted methods employed in acoustics to the important domain of molecular interactions Above a frequency of 4,000 cycles per second the attenuation due to the absorption of sound in oxygen is so rapid that it decreases to a millionth of its initial intensity in travelling a distance of 60 m In an atmosphere of oxygen the consonants of high frequency in speech sounds could scarcely be heard across an ordinary street The absorption of sound in a room at high frequencies is more influenced by the humidity and temperature of the air than by the absorbing boundaries of the room or the audience The 'acoustic transparency' of the air at any temperature and humidity can be calculated A new technique is furnished for investigating not only the nature of molecular collisions but also the nature of the molecular forces involved

The only foreign delegates present at the meeting were the representatives of the South African Association for the Advancement of Science and the Royal Society of South Africa; they were Prof H B Fantham and Mrs Fantham (Dr. Annie Porter), of McGill University, Montreal

The new Committee on Organisation recommended that the Council promote the establishment of local branches, as long since provided for in the constitution It was voted to encourage the formation of such branches under the direction of the general secretary On application of a group of seventy-five persons such a branch was established at Lancaster, Pa, and steps taken to assist in the organisation of other places.

By the courtesy of the Mellon Institute, the annual science exhibition occupied an entire floor of the splendid new building of the Institute The exhibits of the National Bureau of Standards on deuterium and its compounds from twenty-five co-operating laboratories, the Bartol Research Foundation exhibit of cosmic ray apparatus, and the Columbia University demonstration of the production of artificial radioactive substances stood out among a long series of unusual research exhibits for their truly remarkable character

The addresses of the retiring vice presidents, given at various times, included the following. *Mathematics*, Prof Charles N Moore of the University of Cincinnati, on "Mathematics and Science"; *Physics*, Dr. Clinton J Davisson of the Bell Telephone Laboratories, New York City, on "Electron Optics"; *Chemistry*, Prof. Arthur B Lamb of Harvard University, on "Crystallogenetic Adsorbents"; *Astronomy*, Dr Vesto M Slipher of Lowell Observatory, Flagstaff, Ariz, on "The Atmosphere of the Planets as Inferred from Their Spectra"; *Geology and Geography*, Dr. Rollin T. Chamberlin of the University of Chicago, on "Certain Aspects of Geologic Classifications and Correlations, *Zoology*, Dr. George L. Streeter of the Carnegie Institution, Baltimore, Md, on "The Education of an Anatomist"; *Botany*, Dr Karl M Wiegand of Cornell University, on "A Taxonomist's Experience with Hybrids in the Wild", *Anthropology*, Dr. T. Wingate Todd of Western Reserve University, on "Anthropology and Growth", *Psychology*, Dr Walter R Miles of Yale University, on "Training, Practice and Mental Longevity", *Education*, Prof Walter F Dearborn of Harvard University, on "The Mental and Physical Growth of Public School Children", *Social and Economic Sciences*, Prof Wesley C. Mitchell of Columbia University, on "The Social Sciences and National Planning", *Engineering*, Dr Charles F Kettering of the General Motors Corporation, Detroit, Mich., on "Some Future Problems of Science and Engineering", *Medical Sciences*, Dr Cyrus C Sturgis of the University of Michigan, on "Review of Some of the More Recent Advances in the Study of Blood Diseases", *Agriculture*, Dr Albert R Mann of Cornell University, on "The Agricultural Significance of State and National Planning"

The following officers were among those elected for the year 1935 *President*, Prof Karl T Compton of Massachusetts Institute of Technology, *General Secretary*, Prof Otis W Caldwell of Teachers College, Columbia University, *Vice Presidents of the Sections* Prof T H Hildebrandt of the University of Michigan (Mathematics), Dr John T Tate of the University of Minnesota (Physics), Prof Moses Gomberg of the University of Michigan (Chemistry), Dr H. R. Morgan of the U S Naval Observatory (Astronomy); Prof Walter E McCourt of Washington University (Geology and Geography), Dr Oscar Riddle of the Station for Experimental Evolution, Cold Spring Harbor, N.Y. (Zoological Sciences), Prof E. W. Sinnott of Columbia University (Botanical Sciences), N C Nelson of the American Museum of Natural History, New York City (Anthropology), Joseph Peterson of George Peabody College for Teachers, Nashville (Psychology), Shelby Harrison of Russell Sage Foundation, New York City (Social and Economic Sciences), Dr George Sarton of Harvard University Library (Historical and Philological Sciences); H N Davis of Stevens Institute of Technology, Hoboken, N J (Engineering), Stanhope Bayne-Jones of Yale University Medical School (Medical Sciences), H K Hayes of the University of Minnesota (Agriculture); Prof F. B Knight of the University of Iowa (Education)

HENRY B. WARD

Science and the Newspaper Press in the United States

ONE of the leading features of the recent meeting of the American Association for the Advancement of Science held at Pittsburgh, Pennsylvania, was a symposium on the relation between science and the Press. Although within the past decade Press reports of scientific work have become far more satisfactory than formerly, and distrustfulness of the Press on the part of scientific men has been greatly reduced, certain difficulties still exist The object of the symposium was to bring these difficulties frankly into the open, in the hope that recognition and subsequent discussion might lead to their eventual removal.

The speakers at this symposium were Dr Karl T. Compton, president of the Massachusetts Institute of Technology, who is president elect of the American Association; Mr David Dietz, science editor of the Scripps-Howard Newspapers, and president of the National Association of Science Writers, Cleveland, Ohio; Mr. Robert D Potter, Science Service, Washington, District of Columbia, speaking for the director, Mr. Watson Davis; Dr. Edward R. Weidlein, director of the Mellon Institute for Industrial Research, Pittsburgh, Pennsylvania; Mr. William L. Laurence, science news editor, the *New York Times*, New York; Dr. Benjamin C. Gruenberg, American Association for Adult Education, New York; Mr Gobind Behari Lal, science editor, Hearst Newspapers, New York, Mr Thomas R. Henry, staff correspondent, the *Washington Star*, Washington, and Mr Howard W. Blakeslee, science editor, the Associated Press, New York. It is expected that the contributions of these writers and others will be published in a forthcoming number of *Science*.

It was gratifying to note the interest taken in this symposium by the members of the Association, and to observe the co-operative spirit—indeed, the cordial relationship—that now exists between the scientific men and the representatives of the Press. For it is only within the past few years that science and the Press have come really to understand and to appreciate each other.

The present system of reporting science in the Press of the United States may be said to have had its inception in 1921. In that year, the late Mr Edward Willis Scripps established the organisation known as 'Science Service', which had as its object making "the greatest use of the press in the way of disseminating the knowledge which is the result of painstaking research carried on by a few hundred, or at least a few thousand, well trained men with great mental capacity". In the same year the Scripps-Howard newspapers appointed Mr David Dietz as science editor, and Mr Alva Johnston was selected to write the articles on science for the *New York Times*.

The Boston meeting of the Association in 1922 was reported to the Press by Science Service, Mr Dietz and Mr Johnston. For his work in reporting this meeting Mr Johnston was awarded the Pulitzer prize of one thousand dollars for "the best job of reporting done during the year". The award naturally attracted attention to science writing, and within the next few years several other newspapers, among them the *Washington Star*, the *New York Herald-Tribune* and the *Detroit News*, designated young men of outstanding ability as scientific writers for them.

In 1927 the Associated Press, a co-operative Press association furnishing news to about 1,300 newspapers, appointed two of its ablest young men as science editors, whose duty it was to write science exclusively for the member newspapers. In selecting the men for these positions, Mr Kent Cooper, the general manager, adopted the principle that the best results in writing science for the Press are to be obtained by men who are, primarily, trained journalists of exceptional ability. This principle has proved to be sound, and has been generally followed by the Press in the United States.

In April 1934 there was organised the National Association of Science Writers, with the membership limited to staff members of newspapers and press associations who devote their major efforts to science. The purpose of this Association is "to foster the dissemination of accurate scientific knowledge by the press of the Nation, in cooperation with scientific organisations and individual scientists". The charter members were twelve in number, representing the Associated Press (2), Science Service (2), the Scripps-Howard Newspapers, the *Philadelphia Inquirer*, the *Washington Star*, the *New York Times* (2), the Hearst Newspapers, the *New York Herald-Tribune* and the *Detroit News*. One honorary member was elected. Mr David Dietz, science editor of the Scripps-Howard Newspapers, who is a fellow of the Royal Astronomical Society and has attended and reported meetings of the British Association, was elected president.

The growth of interest in science on the part of the Press of the United States is well shown by the fact that at the recent Pittsburgh meeting of the Association there were sixteen science writers from other cities, ten of them members of the National Association of Science Writers. At the meeting in Boston in the preceding year there were ten from other cities. At the Boston meeting in 1922 there had been only four.

Appreciation of the excellent work the science writers connected with the daily Press are doing is being shown in many different ways. As examples it may be mentioned that during the past year the commencement oration at the Massachusetts Institute of Technology, at Cambridge, Massachusetts, was delivered by Mr Howard W. Blakeslee, science editor of the Associated Press, and the commencement oration at the Carnegie Institute of Technology, at Pittsburgh, Pennsylvania, was given by Mr Waldemar Kaempffert, science editor of the *New York Times*. Also, Mr. Thomas R. Henry, science writer for the *Washington Star*, was elected a member of the Washington Academy of Sciences as an appreciation of his work, and shortly thereafter addressed the Academy on the relation between science and the newspapers.

In the United States, the newspapers have now become an important element in the scientific complex of the country. They are by far the most important intermediary between those who are engaged in scientific work and the public at large. As such, they are the most important factor, so far as science is concerned, in what is commonly called adult education. It is a pleasure to be able to state that they appreciate their responsibilities and are doing everything in their power, at no small expense to themselves, for the common good.

University and Educational Intelligence

Birmingham.—The Huxley Lecture is to be delivered on March 14 at 5.30 p.m. in the medical theatre by Sir Thomas Lewis, who has chosen for his subject "Clinical Science within the University".

Cambridge.—Prof. Othenio Abel, recently appointed professor of geology and palæontology in the University of Göttingen, will give three lectures on palæobiology and evolution in the Department of Zoology at 5 p.m. on February 11, 13 and 15.

The Faculty Board of Archæology and Anthropology has appointed T. T. Paterson, of Trinity College, and J. R. B. Stewart, of Trinity Hall, to Anthony Wilkin studentships.

London.—The County Borough Council of Croydon is making a grant of £10,000, payable over ten years, towards the erection of new buildings in Bloomsbury, and the Westminster Bank has granted £500 for the same purpose.

Oxford.—The scientific work of early members of Oriel College was the subject of a public lecture by Dr. Gunther on February 2. The benefactions to the library and list of graduates show that medical studies flourished there at the end of the sixteenth century, when Thomas Coghan wrote his "Haven of Health", for the welfare of students living in Oxford. Special mention was made of the work of Hariot the mathematician, of Merrett and Dyer among botanists, and finally of Gilbert White and of those Tractarians who attended scientific lectures

At a meeting of Congregation to be held on February 12, details of the establishment of a museum of the history of science will be presented It is suggested that the museum shall consist of the collection of scientific instruments and books presented to the University by the late Mr Lewis Evans in 1924, any additions made to the collection since 1924, and any further additions of objects and books illustrating the history of science, with special reference to scientific work in Oxford, as may be accepted or acquired by the University after the passing of the statute A committee, consisting of the Vice-Chancellor, the proctors, and six others, would be appointed The duties of the committee would be to appoint a curator of the museum, to accept or otherwise acquire, outright or on loan, objects and books illustrating the history of science, and to formulate rules for the governing of the museum.

Science News a Century Ago

The Royal Geographical Society

At a meeting of the Royal Geographical Society held on February 9, 1835, an extract was read from the private journal kept by Mr. Oldfield, late surgeon with Mr. Lander, detailing the circumstances which attended the attempt made by the expedition to ascend the Tshadda (Benue), the great eastern confluent of the Quorra (Niger). From these it appeared that the chief difficulty arose from the alarm, and consequent hostility, of the natives, which made it impossible to obtain supplies of provisions. Otherwise the stream, though rapid, running at the rate of 2½ knots, was easily ascended by the steamer, and though navigation of the river was uncertain, the bed of the river being thickly set with small islands and shoals, it was not difficult, and appeared even clearer where the expedition stopped than lower down The utmost extent reached was 110 miles

Chesney's Expedition to the Euphrates

A century ago both the British and Indian Governments were taking steps to further the project of shortening the passage to India by means of steam navigation. In connexion with this, Col. Francis Rawdon Chesney (1789–1872) was entrusted with the task of exploring the route via the Euphrates. For this expedition, Laird's of Birkenhead constructed two small iron steamers, the *Euphrates*, 105 ft. long, 50 h.p., and the *Tigris*, 86 ft. long, 20 h.p., which were to be conveyed to Syria and transported in sections across the desert to the banks of the Euphrates. When ready, the steamers were stowed aboard the sailing vessel *George Canning*, which left Liverpool on February 11, 1835, with some of the members of the expedition Writing of this event, the *Athenaeum* said that it was intended that the *George Canning* should call at Cork, from which place she was to be escorted to the River Orontes by H.M. Steam Vessel *Alban*. Some workmen from Laird's accompanied the expedition, which included also some artillerymen who had been instructed in iron working

While the main object of the expedition was to survey the Euphrates as far as the Persian Gulf, attention was not to be entirely confined to steam communication, for it would provide opportunity, said the *Athenaeum*, "to make the necessary examinations of that celebrated part of the world, where the first human formations may be looked for with confidence" The expedition met with many difficulties and it was not until March 16, 1836, that the steamers began the descent of the river On the passage down, the *Tigris*, with all her journals and surveys, was lost, and Chesney was nearly drowned He, however, continued the voyage in the *Euphrates* and on June 19, 1836, reached the Indian Ocean His account of the expedition was published in 1850

Matthias Baldwin's Locomotives

No one in America contributed more to the improvement of the locomotive than Matthias Baldwin (1795–1866), *who in 1835 transferred his works from* Minor Street, Philadelphia, to Broad Street The Franklin Institute was much interested in his work and on February 12, 1835, the committee on science and the arts of the Institute submitted a report on the locomotives he was then building, in which it found "numerous improvements affecting nearly every part of the machine". The report made special mention of his improvements in the valves, the feed pumps, the reversing gear and the axles and wheels Mr. Baldwin, it was stated, "has completed several engines, one of them may be seen in operation on the Philadelphia and Trenton Rail-road, and four on the state road to Columbia; all of which, as well as one in use at Charleston, South Carolina, have given entire satisfaction by their performance

The Committee are informed that some of these improvements have been secured to their inventor by patents, and that he richly deserves to reap the benefit of them, will be admitted by any one who is aware of the extensive use and increasing demand for these costly structures"

Lyell and the Geological Society

At the anniversary meeting of the Geological Society held early in February 1835, the Wollaston Medal was awarded to Gideon Mantell (1790–1852), the Lewes surgeon who had made a close study of the chalk formations in Sussex. The meeting was followed by a dinner, of which Lyell, the president of the Society, wrote to Mantell: "The dinner went off famously, more than a hundred present. After the toasts had been given of the King, Royal Family, Geological Society, late president and president, I gave you I send you a copy of my speech almost word for word as delivered. . . I assure you I had the feeling of the meeting with me, and in some respects it produced a better effect than if you had been there It was by far the longest toast given, but I am sure they were not tired. Lord Lansdowne, who was on my left hand, asked all about you. I got him to give Oxford and Buckland. Fitton gave Cambridge, followed by Sedgwick; Sedgwick the Royal Society, answered by Lubbock, Buckland the Linnean; I the Astronomical, answered by Baily; Greenough the Geographical, answered by Murchison. We then drank Burnes who made a good speech"

Societies and Academies

LONDON

Royal Society, January 31. R. T. Hill and A. S. Parkes: Hypophysectomy of birds. (6) Plumage changes in hypophysectomised fowls. Hypophysectomy of the Brown Leghorn cock results in the loss of most or all of the black pigment from the feathers of the under-neck, breast and legs. The later growing feathers, particularly, are usually devoid of black and may be extensively fringed. The new plumage over the rest of the body is characterised by loss of black pigment and increase of fringing due to lack of barbules. These changes are so similar to those which follow thyroidectomy that they may reasonably be supposed to be due to thyroid deficiency, which is well known to follow hypophysectomy in mammals. (5) Effect of replacement therapy on the gonads, accessory organs and secondary sexual characters of hypophysectomised fowls. Fowls injected with ox anterior lobe extract for 4–6 days after hypophysectomy all showed a temporary increase in the size of the comb and, in the male, the atrophy of the testes was slightly retarded. Prolonged injection after operation, however, failed to avert (*a*) the comb shrinkage, (*b*) the testes atrophy, or (*c*) the plumage changes, which follow hypophysectomy. Attempts to restore the atrophied gonads and combs of hypophysectomised birds by injections of anterior lobe and urine of pregnancy extracts were comparatively unsuccessful. H. Muir Evans: The brain of *Gadus* with special reference to the medulla oblongata and its variations according to the feeding habits of different Gadidæ (1 and 2). The divergence of opinion of the significance of the various lobes in *Gadus* has necessitated a detailed microscopic examination of serial sections of the medulla of the whiting, the result of which is to confirm the views of Goronowitsch and others, and to dispute the conclusions of C. J. Herrick. The facial lobes described by the former writers are held to be true facial lobes, comparable to the single facial lobe of the roach, as a type of cyprinoid brain, which is the result of the fusion of two facial elements. Different species of gadoids can be classified according to their diet, and both diet and dentition are reflected in the pattern of the medulla oblongata. At one extreme is the haddock, feeding on crustacea and mollusca, with a large facial lobe and a small somatic sensory lobe, and at the other end species like the ling and the pollack, feeding almost entirely on fish, with a small facial lobe and a very large somatic sensory lobe. In between there is a gradual transition both in types of medulla and in feeding habits, as we pass from the haddock to the cod, whiting, ling, pollack and hake. H. W. Florey and H. E. Harding: A humoral control of the secretion of Brunner's glands. The secretion of Brunner's glands of the cat occurs independently of extrinsic innervation. The glands are activated after the taking of food by a blood-borne stimulus—a hormone or secretagogue.

PARIS

Academy of Sciences, December 26 (*C. R.*, 199, 1537–1694)*. Louis Médard: The Raman effect of binary mixtures of sulphuric and nitric acids. A line with frequency about 1,400 cm.$^{-1}$, very intense even with very low concentrations of sulphuric acid (0·005 per cent), is described. This is called the sulphonitric line. Letort: The kinetics and energy of activation of the thermal decomposition of the vapour of acetaldehyde. Raymond Charonnat: Researches on the reaction of J. H. de Boer. Study of the alizarin-zirconyl complex and its reaction with fluorides in acid solutions. Georges Denigès: The micro-estimation of caffeine by colorimetry. A modification of Weidel's reaction giving quantitative results. M. Tiffeneau and Mlle. B. Tchoubar: The vinylic and hydrobenzoinic dehydration of the α-cyclane-glycols. The extension of the hydrobenzoinic transposition to the cyclane series. Mlle. S. Caillère: Study of the dehydration of the fibrous parasepiolite of Madagascar. Jacques de Lapparent: Boehmite and diaspore in the Ayrshire fireclays. Maurice Dreyfuss: Methods for the separation of the clay fraction of the sedimentary rocks. The colloidal suspension of the clay is stabilised by the addition of soap, gum arabic, or preferably gelatine, and the stabilising substance removed by appropriate treatment. Paul Lemoine, René Humery and Robert Soyer: The discovery of the Weald under the Paris region. Edmond Dartevelle and Daniel Schneegans: The fossiliferous deposit of Futa (French Equatorial Africa) and the Quaternary of the coast zone of the Congo. This deposit must be attributed to the Pleistocene. One of the species, *Pachymelania aurita*, characterises the Quaternary deposits of Senegal, Guinea and the Ivory Coast. Robert Laffitte: The Eocene in the eastern Aurès. Léon Moret and Daniel Schneegans: The problem of the limestone Flysch of the mountain of Autapie near Colmars (Basse-Alpes). Marcel Thoral: The age of the Archæocyathus limestones of the Montagne Noire (Hérault, Tarn and Aveyron). Adolphe Lepape: The origin of the helium of natural gases. The localisation of the richest natural gas deposits in the old lake deposits. Analyses of gases from various sources are calculated to show the proportion of helium in the 'nitrogen', and this figure serves as the most useful basis for discussion of the analyses. Camille Dauzère and Joseph Bouget: The cause of the variations of the [electrical] conductivity of the air in grottos. The variations depend on the direction and velocity of the air currents in the cave. R. Faillettaz: A new method of recording atmospherics for the prediction of storms. Frédéric Roman and Marcel Solignac: The discovery of a layer of Pontian mammals at Douaria (northern Tunis). Henri Humbert and Pierre Choux: *Alluaudiopsis fiherenensis*, a new Didereaceæ of Madagascar. Emile Michel-Durand: Metabolism of the phosphorus in the leaves of the mistletoe. William Schopfer: The synthesis of a growth factor by a micro-organism. Raymond Hamet: The production of an isomer of corynanthine by the methyl esterification of its product of alkaline saponification. Auguste Chevalier: The micro-bioclimates of the Cape Verde Islands and the adaptations of the vegetation. Paul Becquerel: The longevity of macrobiotic seeds. Raymond Hovasse: The existence of a parabasal apparatus in the flagellated cells of swimming larvæ of the sea-urchin *Paracentrotus lividus*. R. Moricard: The existence of relations between the gametotrope mitosine, the modifications of the radial vacuome and the start of the precessive reduction mitosis of ovulation and of the formation of the yellow body in the rabbit. Jean Roy: Experiments of crossing and artificial fertilisation realised in *Bryocamptus pygmæus*. Jacques Benoit: Sexual activation

(* *Continued from p.* 199.)

produced by artificial lighting in the duck during the resting period of the sex organs **Etienne Wolff** The experimental production and determinism of an unknown monstrosity, the anterior symely **Albert Goris** and **Henri Canal**. The essence and heteroside of *Primula acaulis*. **Mme Andrée Roche** and **Jean Roche**: The osmotic pressure and molecular weight of the hæmorythrine of the siponcle **Philippe Lasseur** and **Marc Benoit** Observations on the Gram stain. **J Régnier** and **Mlle S Lambin** Study of a case of microbial antagonism (*B Coli Staphylococcus aureus*) **Vito Volterra**. Mathematical discussion of the preceding note **Hector Diacono**: The reversibility of certain metallo protein precipitates by the action of sodium thiosulphate The serological behaviour of the complex arising from hæmolytic sera and syphilitic sera **L Delherm** and **H Fischgold**: d'Arsonval currents diminish neuromuscular excitability **Y Manouélian**. Syphilitic umbilical hæmorrhage and treponemes

GENEVA

Society of Physics and Natural History, December 6 **Jean** and **L Deshusses** Some special insects injurious to crops in French Switzerland **M Gysin**: The metamorphic tillites of Kundelungu and of Haute-Lufira (Belgian Congo) In the region of Haute-Lufira, the conglomerate of the base of the Kundelungu (tillite), instead of being purely detritic, shows an abnormal strongly crystalline facies It contains large crystals of glaucophane-hornblendes, of garnet and of dipyre, as well as numerous thin plates of biotite The pebbles of the conglomerate are laminated and entirely recrystallised The author attributes this metamorphism of the tillites to the perimagmatic actions of the neighbouring diabases, conjugated with the metamorphism of dislocation of the Lufilian orogenesis.

December 20. **M Gysin** Origin of the chloritic rocks of the Haute-Lufira (Belgian Congo) In the Haute-Lufira (Belgian Congo) basin, the sediments of the Kundelungu form a series of parallel folds, oriented W N W-E S E. These folds are marked out by dislocation zones containing tectonic breccia, crushed rocks impregnated with quartz and oligist, chloritic rocks and diabases. The author describes the mineralogical constitution of the chloritic rocks, which are principally formed of a pale green chlorite, colourless in thin section, presenting the characters of leuchtenbergite. The formation of the chlorite appears to be due to the action of mineralised solution on the crushed dolomites, more or less metamorphosed by the diabases. **E. Joukowsky** and **J Buffle**. Observations on the salts dissolved in the surface waters and the phreatic waters of the Canton of Geneva. The authors give some indications on the relations existing between the water of the Arve and the underlying phreatic sheet. They quote some figures for dissolved salts which appear to prove that the river does not dissolve material picked up from the bed and carried along, at least for a distance of 25 km. **Weigle** and **Saini**: The structure of ammonium bromide at a low temperature. The study of ammonium bromide by means of the X-rays (powder method, with high dispersion) has shown that below − 39° C. this salt is no longer cubic; it becomes tetragonal. **Weigle** and **Luthi**: The dispersion of butyl alcohol for 9 cm. waves. **P. Balavoine**: The present hygienic state of the waters of rural springs of Genevan territory.

LENINGRAD

Academy of Sciences (*C R*, 4, Nos. 1–2) **S Bernstein**: Trigonometric interpolation by the method of least squares **P. Novikov**: A generalisation of the second principle of separability **S Leitmann** and **S Uchodin**: The combined dispersion and the association of molecules **I Chvostikov** Fluorescence of solutions of platinum cyanides **G Rumer** Contribution to the wave theory of the neutron **S Artsybyshev** and **U Parfianovich** Penetration of copper into rock salt by electrolysis The rate of diffusion of copper ions into rock salt at different temperatures follows the exponential law. **A Levashov** Problem of relativisation of the classical mechanics (1) **G Gimmelmann** and **M Neumann** Spark ignition of a mixture of methane and oxygen **A Kudrevatov**. Analysis of calcium fluoride **M Kabachnik** and **M Katznelson** Amidation in the alkaloid series by means of sodium and potassium amides (2) The α- and α′-aminoanabasines **F Berezovskaja**, **M Kogon** and **E Moskalenskaja** Combined action of ultra-violet radiation and of platinum on the transformation of fumaric and the maleic acids and of their salts **P Lazarev**, **A Gamburceva**, **S Abrikosov** and **B Shaposhnikov** Influence of the illumination of human skin on the adaptation of the eye during peripheric vision The limit of the visual reception decreases after the insolation of the skin This suggests that the ultra-violet rays produce certain substances in the skin which are absorbed into the blood and affect certain brain centres **P Lazarev**. Laws of action of light on the eye and on the skin The sensitiveness of the skin and of the eye to light is subject to analogous variations according to seasons, physiological state of the organism, etc. **V Alpatov** and **O. Nastiukova** Influence of ultra-violet radiation on the division rate of *Paramecium caudatum* in relation to temperature during and after radiation. **A Bajev** Formation of ammonia and respiration in the erythrocytes of birds. **H J. Muller** and **A Prokofieva**: Continuity and discontinuity of the hereditary material **G Lewitsky** and **M. Sizova**: Regularities in chromosome transformations induced by X-rays **R Dozorceva**. Artificial mutations in *Pteromalus puparum* induced by radium irradiation The irradiation by β- and γ-rays intensified the mutation process, but many of the mutations are lethal **A Guhl**. Mutations produced by X-rays in the parasitic wasp, *Pteromalus puparum* Results were similar to those described in the preceding paper **A. Prokofjeva**. Morphological structure of chromosomes of *Drosophila melanogaster* **M Belgovskij**: Effect of hybridisation on mutability of the white gene in *Drosophila simulans*. It appears that hybridisation cannot increase the spontaneous mutation rate to a significant degree, and therefore it cannot be considered an important factor in evolution.

MELBOURNE

Royal Society of Victoria, December 13 **Leo W Stach**: The genera of Catenicellidæ. The status of generic names applied to the Catenicellidæ is discussed, and a systematic synopsis is appended which includes descriptions of the new sub-families Catenicellinæ, Cornuticellinæ and Ditaxiporinæ The following new genera are also described: *Carinatocella*, *Cornuticellina*, *Ditaxiporina*. The new name, *Carinatocella harmeri*, is proposed to replace *Catenicella carinata*, Busk, 1852 (non d'Orb. 1851).

Washington, D.C.

National Academy of Sciences (*Proc.*, 20, 565-599, Nov 15, 1934) T. E. Sterne. The accuracy of least squares solutions (see Nature, Sept 15, 1934, p 421) Garrett Birkhoff Ideals in algebraic rings. Nathan Kaplan V_3 in R_4 of $[1,2]_4$ P A Smith The fundamental group of a group manifold H S Vandiver On the foundations of a constructive theory of discrete commutative algebra H B Curry Functionality in combinatory logic George H Shortley · The calculation of relative multiplet strengths in a transition array. S. S Stevens and E B Newman The localisation of pure tones Tones were generated by a loud speaker, which was mounted on a 12-ft. horizontally rotating arm able to move round an observer on a platform 9 ft above the roof of a building, thus avoiding reflection by vertical surfaces The observer was asked to locate, by ear and without moving, the position of the loudspeaker working at different frequencies. Accuracy of localisation below 1,000 cycles and above 7,000 cycles is roughly the same, between 2,000 and 4,000 cycles it is relatively poor and a minimum This suggests a dual mechanism for localisation : phase-difference at the two ears for low frequencies, and intensity-difference for high frequencies G H Parker Acetyl choline and chromatophores When protected from destruction in the blood by physostigmine, acetyl choline induces slight concentration of melanophore pigment in fish (blanching) Heavy doses limit heart action, and the resulting loss of circulation induces melanophore dispersion (darkening)

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, February 10

British Museum (Natural History), at 3 and 4 30 — H W Parker "Reptiles of Commerce" *

Monday, February 11

British Museum (Natural History), at 11 30 — Miss L E Cheesman "The Mountains of Papua" *

Victoria Institute, at 4 30 — Rev D E Hart-Davies. "Biblical History in the Light of Archæological Discovery since the year 1900" (Gunning Prize Essay).

Royal Geographical Society, at 5 — Major R A Bagnold "The Movement of the Desert Sand"

University College, London, at 5 — Dr R H. Ing "The Chemical Structure of Drugs in relation to their Physiological Action" (succeeding lectures on February 18, 25, March 4, 11 and 18) *

Tuesday, February 12

Pharmaceutical Society of Great Britain, at 8 30 — Sir Robert Robertson "The Work of the Government Laboratory"

Thursday, February 14

London Mathematical Society, at 5 — (in the rooms of the Royal Astronomical Society, Burlington House, W 1) — Dr Max Born "Quantum Electrodynamics".

Bedford College for Women, at 5 15 — Comm. R T Gould "Ways of Measuring Time—Modern Clocks" *

Chemical Society, at 5 30 — (at the Institution of Mechanical Engineers, Storey's Gate, London, S W.1). — Prof R Whytlaw-Gray "The Process of Coagulation in Smoke" (Liversidge Lecture).

Royal Empire Society (Education Circle), at 8 — Discussion on "How Africans Educate Themselves", to be opened by the Rev. E W. Smith

Friday, February 15

Association of Applied Biologists, at 2 30 — Annual General Meeting to be held at the Imperial College of Science and Technology, South Kensington, London, S W 7 *

Geological Society of London, at 3 — Annual General Meeting

J F N Green "The Moines" (Anniversary Address)

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 15 The Cellulose of Marine Algæ By Dr Thomas Dillon and Tadhg O'Tuama Pp 147–152 6*d* Vol 21 (N S), No 16 The Thermal Decomposition of Hydrogen Peroxide in Presence of Glass Wool and Copper Sulphate By Dr Kenneth C Bailey Pp 153–164 1*s* Vol 21 (N S), No 17 On the Preparation and Properties of Alginic Acid and on the Extraction of Marine Algæ with various Solvents (Preliminary Note) By Vincent Barry and Dr Thomas Dillon Pp 165–166 6*d* (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd)

Modern Anthropology versus Biblical Statements on Human Origin By Sir Ambrose Fleming Pp 25 (London Victoria Institute) 1*s*

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 18 A Crate for the Collection of Fæces and Urine adjustable for Metabolism (Solid and Liquid) Experiments with Pigs, Sheep and Cattle of various Sizes By E J Sheehy Pp 167–178 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 6*d*

Weather Studies, No 1 Unofficial Meteorology By Sir Napier Shaw Pp 26 (Huddersfield Thunderstorm Census Organisation) 1*s*

The Journal of the Institute of Metals Vol 55 (No 2, 1934) Edited by G Shaw Scott Pp 304 + 17 plates (London Institute of Metals)

Proceedings of the Royal Irish Academy Vol 42, Section B, No 8 A List of the Irish Hemiptera (Heteroptera and Cicadina) By J N Halbert Pp 211–318 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 3*s* 6*d*

Annual Report of the New Commonwealth, 1933–1934 Pp 64 + 5 plates (London The *New Commonwealth*)

Report of the Television Committee (Cmd 4793) Pp 27 (London H M Stationery Office) 6*d* net

The National Institute of Industrial Psychology Report 6 A Vocational Guidance Research in Fife By Dr F M Earle and J Kilgour Pp 101 4*s* 6*d* A Contribution to the Problems of Vocational Guidance in Great Britain Pp 27 (London National Institute of Industrial Psychology)

The University of Durham (Durham Division) Department of Science Record of the Period October 1924 to December 1934 Pp 21 (Durham)

Other Countries

Osmania University, Hyderabad Publications of the Nizamiah Observatory Astrographic Catalogue 1900 0, Hyderabad Section (Part 3), Dec + 36° to + 39°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of T P Bhaskaran. Vol 9 Measures of Rectangular Co-ordinates and Diameters of 65,782 Star-Images on Plates with Centres in Dec + 39° Pp xxv + 239 (Begumpet Nizamiah Observatory, London Percy Lund, Humphries and Co, Ltd) 15 rupees, 20*s* net

Conseil Permanent International pour l'Exploration de la Mer Bulletin hydrographique pour l'année 1933 Pp x + 118 (Copenhague Andr Fred Høst et fils) 7 00 kr

Geological Series of Field Museum of Natural History Vol 6, No 5 The Auditory Region of an Upper Pliocene Typotherid By Bryan Patterson Pp 83–89 10 cents Vol 6, No 6 Upper Pre-Molar Structure in the Notoungulata with Notes on Taxonomy By Bryan Patterson Pp 91–111 20 cents Vol 6, No 7 Cranial Characters of *Homalodotherium* By Bryan Patterson Pp 113–117 10 cents Vol, 6, No 8 *Trachytherus*, a Typotherid from the Deseado Beds of Patagonia By Bryan Patterson Pp 119–139 15 cents (Chicago)

Carnegie Institution of Washington Report of the Editor of the Division of Publications (Reprinted from Year Book No 33, for the Year 1933–34) Pp 360–390 (Washington, D C)

Travaux de la Station zoologique de Wimereux Tome 10 Contribution à l'étude des Cnidaires et de leurs Nématocystes, 1 Recherches sur les Nématocystes (Morphologie, physiologie, développement) Par Dr Robert Weill Pp iv + 347. 125 francs Tome 11 Contribution à l'étude des Cnidaires et de leurs Nématocystes, 2 Valeur taxonomique du Cnidome Par Dr Robert Weill Pp iii + 349–701 125 francs (Paris Laboratoire d'évolution des êtres organisés, Les Presses universitaires de France)

Catalogues

Sports and Pastimes Books on Angling, Big Game, Horses Hunting, Mountaineering, Shooting and Miscellaneous Pastimes (Catalogue No 581) Pp 38 (London Francis Edwards, Ltd)

Electrical Thermometers and Pyrometers (List No E/10) Pp 52. (London · Negretti and Zambra.)

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Scientific Adventure and Social Progress

THE national lecture by Dr T R Glover on the challenge of the Greek, broadcast on December 19, vividly recalls in its plea for the classical discipline one of the most suggestive passages in Prof A N Whitehead's "Adventures of Ideas" In brief compass, Dr Glover set forth the antithesis which Greek customs, ways of living and outlook on life present to those characteristic of this age, and suggested certain aspects of Greek life which are worthy of our consideration

The five aspects discussed by Dr Glover are so interrelated that an attempt to differentiate between them in order of importance is largely beside the mark Few to-day, for example, whether interested principally in science, in art, in industry, in politics, or in society as a whole, would deny the fundamental importance of creative thought as the mainspring of constructive action, or that such thought is one of our most urgent needs This pre-eminent characteristic of the Greeks cannot, however, be dissociated from their capacity to interpret life, to see life steadily and to see it whole, from their essential young-mindedness and adventurousness, their individuality and passion for self-expression, their freedom of enterprise

The tragedy of the present day lies largely in the senility of mind with which, over whole ranges of industrial, social and political problems, we are confronting opportunities which are stupendous compared with those possessed by the Greeks There is scarcely a field of human enterprise and thought, from the unemployment situation, disarmament and tariffs to transport or county planning, in which the powers and opportunities given into our hands by science are not being misused, abused or lost through lack of courage and magnanimity Truly did the prophet exclaim "where there is no vision the people perish"

This inelasticity of mind has two consequences It limits or even excludes the experiments which younger and more adventurous minds would make, and it severely discourages the multiplication of youthful and independent types of leaders While it becomes more and more difficult for youth to gain experience of leadership and to demonstrate its capacity, the growing standardisation of life to which Dr Glover directs attention threatens to stifle such aspirations at the source Russia seems intent on producing citizens of a single type: Italy and Germany equally appear to discourage individuality and independence of mind, a shrewd observer suggests that in the United States the object of education is to turn the human mind into a card index, and education in Great Britain is characterised by much the same standardisation and conformity to type The danger of the breakdown of civilisation through sheer inability to maintain the quality of administration and consequent social equilibrium foreshadowed by Brook Adams in his "Theory of Social Revolution" is apparent alike in the democratic State or under dictatorship

The contrast between this standardisation and mechanisation of life to-day and the glowing vitality of the Greeks which Dr Glover depicted so vividly is worth consideration The challenge thrown down is fundamentally one of thought If the adventurous, speculative mind, dynamic and eager for novelty, which the Greeks possessed, is one of the most essential factors for recovery of control over our specialised activities, the thrusting energy of our sectional and selfish interests, and to afford free access to everything in our rich heritage of civilisation which we have the capacity to enjoy, the most 'un-Greek' thing we can do, as Whitehead points out, is to copy the Greeks

In the very suggestion of imitation or copying there is a hint as to our fundamental trouble In an age of unprecedented change and technical advance, a tendency to take the Greek and Roman civilisation at its best as a standard, and to aim at reproducing the excellencies of these societies, is too static an ideal and neglects the whole range of opportunity It is no longer sufficient to direct attention to the best that has been said and done in the ancient world. The result is static repression, and promotes a decadent habit of mind that can be traced in certain countries to-day

Undue reliance upon the past for guidance and as a standard is a danger to any age. In this present age the peril is even more acute The increasing *tempo* of technical development makes reliance on the wisdom of the past increasingly unsound We are living in a period of human history when, probably for the first time, the assumption is false that each generation will live substantially amid the conditions governing the lives of its fathers, and will transmit those conditions to mould with equal force the lives of its children.

This fact alone would explain many of the difficulties in which we find ourselves, our persistent pursuit in economic and international affairs of mutually inconsistent policies The shortened time-span of technological change increases the disturbance of social and economic life by the application of scientific discovery and in turn demands greater powers of adaptation and readiness to adopt new methods akin to these characteristic of the Greek. Our training must prepare the individual to face conditions for which the past is an imperfect guide. We require such an understanding of the present conditions as may give us some grasp of the novelty which is about to affect the immediate future

We are here confronted with that divorce between wisdom and knowledge which is an untoward characteristic of many departments of political, industrial and social life Despite known gaps in our knowledge of the social sciences, we have already vast stores of knowledge which could be utilised for the re-building of a social order capable of meeting the new conditions and making available for all the great resources with which now for the first time science has endowed mankind Between that age of abundance for all, and the deprivations and distresses of the present time, stand the ideas inherited from a more static age in which available resources were incredibly smaller, and the routine in which those ideas have crystallised themselves Routine, which should be the servant of society, is in a fair way to become its master

It is fashionable at the present time to blame the machines for the mechanisation of life and the uniformity in working and in leisure hours imposed upon whole sections of the community To do this is to make the fundamental mistake of regarding the machine as the master and not the servant of society, and to forget that the most regrettable results of industrialisation are for the most part not the direct fault of technology but of economic developments. As regards the technical and scientific aspects, in fact, our technical and industrial development was historically unavoidable Mechanical power, as Mumford remarks in "Technics and Civilisation", is no new thing, but in earlier ages men had saner ideas of labour-saving devices, and the water mills of the first century B C. were welcomed by Antipater of Thessalonica as a means of enjoying the fruits of Demeter without labour. The mechanisation of industrial and social life to-day is due essentially to our failure to understand the machine and to use it to serve and not to dominate the life of man. In our search for stability we have organised society to a point at which routine, upon which civilisation is undoubtedly founded, becomes an obstacle to progress and adaptation to the new conditions

The absence of foresight in itself explains the lack of leadership Men seek security in the dull conformity to type Despite the many elements of scientific and sociological discipline required in the modern business mind, there is little of that power of general thought, undaunted by novelty, which is the gift of philosophy in its widest sense The absence of such a co-ordinating philosophy of life permeating the community spells decadence, boredom and the slackening of effort The mere compulsion of tradition has lost its force, or even may urge us into dangerous paths As Whitehead reminds us, our fundamental task is to re-create and re-enact a vision of the world, including these elements of reverence and order without which society lapses into riot, and penetrated through and through with unflinching rationality That is the challenge of the Greeks to our age, and whether we rise to the greatness of our opportunities, exploiting its adventure and mastering the network of relations which constitutes the very being of this epoch, or whether we collapse before the perplexities confronting us, depends both on our courage and our intellectual grasp

This challenge is unescapable. Advance or decadence are the only choices offered to mankind Perfection is essentially dynamic and not static Whether we are at present in a period of slow decline, or whether we are in a period of transition to a new form of civilisation involving in its dislocations a minimum of human misery, it would be rash to prophesy There are regions of human endeavour in which creative thought is still sufficiently active to inspire the hope that it may infect the more sterile regions of politics and sociology, where originality and constructive thought are so sorely needed The trend of discussions on the relation of science to social problems within the last two years justifies the belief that in this field thought has run ahead of realisation, and that only courage and vigour are required to secure the realisation of those dreams

The challenge presented to us so vividly alike by Dr Glover and Prof Whitehead is one to which the scientific worker above all should respond He is becoming increasingly conscious that, as the exploration of the physical world proceeds apace, the reaction of the new knowledge upon the social order, of which he himself forms a part, is opening up new fields of endeavour in which his method and impartial questioning spirit can find ample satisfaction He will remember that the great ages of the past have, on the whole, been the unstable ages the great achievements, the adventures of the past He will look back in a spirit of adventure, understanding the past, and look forward in the same adventurous spirit which unlocks the secret of the past, to the wide fields as yet largely untrodden, within which science may yet render its greatest services to mankind and make the rich resources of Nature available for all in a new social order worthy alike of the prodigality of Nature and of man's own rich intellectual heritage.

Reviews

Isomerism and Tautomerism

Tautomerism. By Dr. J. W. Baker (Twentieth-Century Chemistry Series) Pp viii+332. (London · George Routledge and Sons, Ltd, 1934) 25*s* net

THE term 'tautomerism' was introduced by van Laar in 1885 in order to describe those cases in which the compounds represented by two different structural formulæ are found to be "not isomeric but identical" A pioneer example of this phenomenon was discovered in benzene, since Kekulé, so long ago as 1870, was content to regard the single and double bonds in his formula as merely an instantaneous picture of a moving system, in which the double and single bonds were incessantly changing places. In this way he was able to account for the fact that the 1 . 2 and 1 : 6 di-derivatives of benzene are, as Laar expresses it, "not isomeric but identical" Kekulé's migrating bonds would now be described as a flow of valency electrons, and the phenomenon would perhaps be described as *electromerism*, but his fundamental ideas are still valid Indeed, at the present day, chemists would probably be unanimous in saying that *all* the diverse formulæ which have been assigned to benzene represent merely different aspects or phases of the same molecule, which they would not attempt to isolate

The examples cited by van Laar were, however, selected from a different range of compounds, namely, those in which a mobile hydrogen atom can occupy two alternative positions in the molecule Their interconversion—which is now usually described as *prototropy*—instead of involving a mere shifting of bonds or wandering of valency electrons, calls for the displacement of a much more substantial atomic nucleus, and, although this nucleus is only a proton, it has not the same mobility as an electron. Almost as soon as van Laar's theory was announced, therefore, it was proved to be wrong by the isolation as independent chemical compounds of products which he postulated to be identical, but which in fact were entirely different in their physical, and even in some of their chemical, properties. Laar's own theory of tautomerism therefore died in infancy, even if it was not actually still-born; but, since the name which he invented has survived to form the subject of the present monograph half a century later, one may well ask how this has been achieved.

The answer is in some respects a simple one. The pairs of prototropic compounds, which Laar cited as examples of tautomerism, differ as widely as any other isomers in physical properties, such as colour, solubility, melting point, etc., and are distinguished from other isomers only in their ready interconversion. In particular, compounds of this type usually revert to an equilibrium mixture in presence of a mere trace of acid or alkali. They therefore give identical chemical reactions, except under special conditions, for example, in presence of a chemical reagent which has no strong catalytic properties or may even act as an anti-catalyst. At the meeting of the British Association in Oxford, the Chemical Section, under the presidency of Prof. J. F. Thorpe, recognised this point of view by adopting more or less unanimously the definition of tautomerism in the "Oxford Dictionary". This Oxford definition describes the phenomenon of tautomerism as follows :—"This term is applied to the property exhibited by certain compounds of behaving in different reactions as if they possessed two or more different constitutions; that is, as if the atoms of the same compound or group were arranged in two or more different ways, expressible by different structural formulæ."

This anonymous definition is purely chemical in character, since it is based exclusively upon the dual reactivity of a tautomeric compound, and is independent of the possibility of isolating the two 'phases' or 'forms' from which the two types of product are derived. This aspect is indeed so important that it is probable that no better selection could be made of a characteristic on which to base a *re*definition of the term in question. Others have, however, been attempted, since Kurt Meyer in 1913, and Schmidt in 1926, have proposed to limit the phenomenon to cases of prototropy, by insisting that the two sets of derivatives must be derived from two parent substances, which *differ from one another only in the position of a hydrogen atom and of one or more double bonds*. On the other hand, the author of the present monograph wishes to widen the term to include all examples of interconvertible isomers, and is bold enough to claim "universal acceptance" for the view that "*tautomerism is to be regarded as reversible isomeric change*."

The phenomenon of 'reversible isomeric change', which the reviewer has described as '*dynamic isomerism*', was discovered eight years before the appearance of Laar's paper, by Butlerow, who also recognised that it might proceed either with or without an added catalyst. His observations provide a valid explanation of the dual reactivity which Laar explained by an untenable theory; but chemists in general have never accepted the conclusion that Laar's term should be made to cover the whole range of the phenomenon discovered by Butlerow, and in practice there are many well-established cases of equilibrium between isomers which are generally excluded from the most inclusive of working definitions of tautomerism. Thus even the author of this monograph, in spite of his all-embracing definition, has nothing to say about isomeric changes in the benzene series, such as the conversion of hydrazobenzene into benzidene, or about the Beckmann change in the oximes, or about the combined bromination and reduction (by bromine and hydrogen bromide) which converts $\alpha\alpha'$ into $\alpha\beta$-dibromocamphor. General usage is, indeed, opposed to describing as tautomeric any isomers which only become interconvertible under special or drastic conditions, and which under normal conditions give no indications of the dual reactivity on which the Oxford definition is based.

The author's proposal to identify 'tautomerism' with 'dynamic isomerism' is a clear violation of the agreement reached at Oxford; but it has the advantage of enabling him to extend the scope of his book to include many topics which would otherwise have been excluded. Thus, in addition to the keto-enol change in the diketones and the facile isomeric changes which give rise to mutarotation, for example, in nitrocamphor and in the reducing sugars, he has been able to include as examples of the "three carbon system" some modern variants of Butlerow's interconversion of olefines, and to discuss a series of isomeric changes in the terpene series, where the conditions are equally severe. The book therefore provides a valuable guide to the widespread researches which have developed from J. F. Thorpe's work on glutaconic acid, as well as to much of the earlier and contemporary work on related subjects.

A theoretical basis for these researches is provided in an early chapter on the "Modern Theory of Tautomeric Change" and by reprinting in an appendix a paper by Prof C K Ingold on the "Significance of Tautomerism and of the Reactions of Organic Compounds in the Electronic Theory of Organic Reactions" , and the formulæ used in the text are accompanied by the curved arrows by which the theories in question are commonly expressed On the other hand, it may well be asked whether the author really believes in the 'bridge-bond', stretched to twice the normal length of a carbon-to-carbon bond, which he has included in one of his formulæ for anthracene (p 275), in defiance of the physical evidence as to the intolerable strain which such an extension must impose

The book is produced in an attractive form, with adequate subject and author indexes, and should have a wide circulation among chemists

T M L

Electron Physics

Einfuhrung in die Elektronik die Experimentalphysik des freien Elektrons im Lichte der klassischen Theorie und der Wellenmechanik Von Dr Otto Klemperer Pp xii + 303 (Berlin Julius Springer, 1933) 19 80 gold marks

PHYSICISTS have long felt the need of a book on electronic phenomena, in which experimental methods and results are collected together in a convenient form for reference Dr Klemperer has collected and sifted his material with great care and discrimination As a handbook for workers with electrons, his book will be an invaluable help A great number of useful tables and graphs are scattered throughout the work On p 12 we have a list of the formulæ, relationships and numerical values of the velocity and energy expressions for the electron , this is followed by a table, constructed from one given earlier by M G Fournier, containing numerical data for electrons of all velocities, and the curvature of their paths in different uniform magnetic fields From the last value given we see that if an electron moves very little less slowly than light, namely in the ratio 0 99999999870 to 1 (corresponding to a volt-velocity of 10^{10}), the mass increases to 19,585 its rest value

Details are given for obtaining electron beams of different kinds The varying types of information given by a Wilson cloud-chamber, and an ionisation chamber, a point counter and a Geiger-Muller tubular counter are clearly contrasted There is a very useful section on the photographic action of electrons and methods for comparing the intensity of electron beams photographically An account of electron diffraction is given in Chap v, which is entitled "The Electron as a Corpuscle and as a Wave" The calculations given in the book are of the simplest kind throughout A later chapter on the atomic electrons includes a very concise but reasonably complete description of atomic structure and spectroscopic notation (for one and more electron systems) Further subjects dealt with are photo-electric effect, thermionics, Compton effect, secondary electrons, ionisation in all its forms, interactions between free electrons and atoms, energy losses in collision, absorption of electrons and effective cross-section of atoms and molecules

The author discloses an intimate knowledge of these different fields and gives more than a thousand references to original papers There appear to be but few errors We note one in the small table at the top of page 3, and on page 150, Fig 97 for the results of Davis and Goucher's experiment is drawn too symmetrically about the x-axis The author deserves the thanks of all colleagues who are experimenting with electrons, whether fast or slow, and also of those who wish to have a complete summary of electronics for quick reference

H L B

Dialectical Materialism

(1) *Aspects of Dialectical Materialism* By H Levy, Ralph Fox, J D Bernal, John Macmurray, R Page Arnot, E F Carritt Pp vi + 154 (London Watts and Co , 1934) 5*s* net

(2) *The Web of Thought and Action* By H Levy (The Library of Science and Culture) Pp vii + 238 (London Watts and Co , 1934) 7*s* 6*d* net

(1) "THESE essays have arisen in response to an urgent demand that the philosophy guiding the practice of Modern Russia might be expounded in a form intelligible to the layman " A praiseworthy object indeed, since it is of the first importance that dialectical materialism should be lucidly expounded , then it will be possible to discuss the issues involved in the new philosophy , but few readers will get much enlightenment from this volume

Out of the six essays, the fifth, by Mr Bernal, alone attempts any general exposition It is written in a tone of strident dogmatism, take-or-leave-it style The exposition is anything but lucid , that this is not merely the judgment of a biased bourgeois reader may be gathered from the concluding essay by Mr Carritt The latter, who thinks that Marx would have found him a "hopeful convert", enumerates fifteen doctrines which he regards as "common to Mr Bernal and himself". Then he goes on to explain his disagreements with Mr. Bernal. But we need not bother about these disagreements because there are in fact no agreements. Mr. Bernal, who is allowed a postscript, says that "the fifteen articles of Mr. Carritt's cannot be said to be dialectical materialism, or even a part of dialectical materialism". He goes on to rub this in in a fashion that cannot be regarded as complimentary to the Oxford philosopher. So the inquiring reader is likely to rise up from a perusal of the book somewhat bewildered.

The four preceding essayists are more concerned with telling us about the impression made upon them by the new philosophy than by expounding it. To Prof. Macmurray, dialectical materialism is "a revolution in the conception of philosophy itself". It attracts him because "it is the one system of philosophy that recognizes the relation which necessarily exists between any philosophy whatever and the social conditions from which it arises". If this is a revolution or a revelation to philosophers, it is scarcely so to ordinary people; third-rate novelists a hundred years ago recognised that a man's philosophy was conditioned by his social status and tradition. For the rest, Prof. Macmurray is critical. Thus there is no agreement about fundamentals between the contributors; what they do share is a dislike of "capitalism". "Capitalism must strive towards high prices and scarcity," says Prof. Levy; and that of course reminds us of those recent and very successful capitalistic enterprises, Woolworths and Marks and Spencer.

Prof. Levy is the author not only of the first essay in this volume but also of the other book under review (2). The latter takes the form of conversations with "Mr. Everyman", an engineer, a politician (Sir Herbert Samuel) and others. Each conversation is followed by comments. This form of literature seems to be getting popular, but to some readers it is tedious. These conversations lack the interest of vivid reality in spite of the effort to impart it by a familiar and jocular tone; to be attractive they demand unusual imagination and literary skill, which are lacking here.

We are gradually led to the view that politics and history must be studied as sciences. But many workers in these fields would reject this view and would maintain that our difficulties largely arise from the misapplication of the methods of the natural sciences to social studies. The historian and the sociologist do not participate in these discussions. The "social historian" in these conversations is understood to have written a school textbook of physics, and his qualifications for expounding social studies are not apparent.

S.

Problems of Crossing-Over

Handbuch der Vererbungswissenschaft. Herausgegeben von E. Baur und M. Hartmann. Lieferung 19 (Band 1): *Faktorenkoppelung und Faktorenaustausch*. Von Curt Stern. Pp. vii + 331. (Berlin: Gebrüder Borntraeger, 1933.) 54 gold marks.

THE physical basis of crossing-over is now one of the major problems in genetics. Its solution will require a more detailed correlation of genetical results with the behaviour of the pairing threads in meiosis than has yet been made. The very extensive genetical facts already accumulated, and set forth at length in the book before us, call for a cytological explanation; but it is safe to say that all the theories hitherto put forward are defective either in supporting observations or in interpretation or in both. Yet it appears that the problem has now reached a point where it can only be solved by the cytologists, with such further aid as genetics can give.

This most intricate problem of cytogenetics clearly involves a fuller understanding of the structure and division of chromosomes and the relations of mitosis to meiosis, as well as the precise behaviour of the leptotene and zygotene threads. The structure and division, as well as the behaviour of these threads, and the nature of the gene itself, are no less concerned in the solution of this problem. It may be expected that much of cytology in the next decade will centre about these questions. New methods of attack will have to be devised and new points of view developed.

In the present work by Prof. Stern, the abundant facts and theories of linkage and crossing-over are set forth *in extenso*. While *Drosophila* supplies the largest single body of data, yet evidence of equal importance is furnished by many other plant and animal organisms, including *Zea*, *Lathyrus*, *Primula*, *Oenothera*, *Pisum*, *Apotettix*, and others. Such phenomena as coincidence and interference in crossing-over and the linkage problems of three or more factors are discussed both theoretically and on the basis of the known results. In the cytological aspect the views of Janssens, Belling, Darlington, Sax and others regarding the rôle of chiasmata are considered. A short final section on interchromosomal linkage is devoted mainly to experimental cases in maize and *Drosophila*, with brief references to the well-known conditions encountered in *Datura* and *Oenothera*.

This book, which has involved the author in much labour, will serve as a very useful storehouse of facts and a clearly arranged work of reference for future investigators.

R. R. G.

Short Notices

Crystals and the Polarising Microscope a Handbook for Chemists and Others By Dr N H Hartshorne and A Stuart Pp viii+272 (London Edward Arnold and Co , 1934) 16*s* net

SECTIONS 1 and 2 of this book deal with crystal morphology. The information included in the fifty pages is surprisingly complete It is to be regretted, therefore, that the authors have not made use of the stereographic projection (space could have been found by deleting the recapitulations on pp 50 and 92) The use of etch-figures in, say, distinguishing between ortho- and clino-pinacoids and these in turn from prisms, might have added to the completeness of this portion of the book The text is liberally illustrated with clear diagrams (In Fig. 31, $1\bar{1}1$ should read $1\bar{1}0$ and on p 44, lines 6, 7 and 11 from top should be . 2{100} 4{101} and $6\{10\bar{1}1\}$)

It is difficult to refer to the optical treatment (Sections 3–6) without enthusiasm The ground covered would not be amiss in a volume of twice the size, and descriptions are throughout clear and concise The drawings, hereabouts, serve their purpose well, those of interference brushes, viewed through differently orientated sections, being particularly useful Some confusion may result from the authors' description of the mica plate It is the practice in Great Britain for quartz, mica and gypsum plates to be cut with the longer edge parallel to the ϵ or γ axis of the ellipsoid (Miers, Tutton, etc) In Sections 7 and 8, the authors make out a good case for the increased use of the polarisation microscope in industry and research

The printing is clear, and authors and publishers are to be congratulated on a book, useful alike to research physicists, geologists and crystallographers, as well as to chemists H E B

Sexual Life in Ancient Rome By Otto Kiefer Translated from "Kulturgeschichte Roms unter besonderer Berucksichtigung der Romischen Sitten" by Gilbert and Helen Highet Pp ix+379+16 plates. (London . George Routledge and Sons, Ltd , 1934) 25*s* net

IN matters relating to sex, the ancient Romans displayed the practical qualities which they brought to bear on all the problems of their lives, both public and private It affected their attitude generally to all forms of erotic emotion, as well as in the relation of the sexes For it has to be remembered that the ancient Romans, if not universally, very commonly, were indifferently homo- and heterosexual, and accepted that as a matter of course Dr. Kiefer, in the work of which this is a translation, has explored the records of the reactions of the Roman world in marriage, in religion, in literature and in art, and finds not only that there is little of the spiritualisation of this emotion such as existed among many of the Greeks, but also that there is in it no little of a sadistic element He is, however, by no means a supporter of the view which would ascribe the downfall of the Empire to decadent mores in relation to sex An acute analysis of the sexual element in the character of certain of the early emperors and members of their entourage, discounts the scandals of their biographers in some, but not all, instances

Satellite Station Tables By C M L Scott Pp vii+44 (London Edward Arnold and Co , 1934) 12*s* 6*d* net

IT sometimes happens in minor triangulation that well marked objects, which are otherwise suitable as trigonometrical points, cannot be observed from, though they are well placed for observing to' Burma, with its innumerable pagodas, offers thousands of examples of this, and it is not surprising that the book under review should have been written by the port surveyor at Rangoon These tables will save labour in cases in which there is much satellite-station work, though in ordinary minor triangulation, in which satellite stations are usually avoided, or are but rarely used, the surveyor may prefer to make his corrections by the application of elementary trigonometry

The tables have been carefully prepared and are well set out and printed. They are suitable for the purpose intended, which is, briefly, to reduce the angles taken at a satellite station to the values which they would have had if they had been observed at the inaccessible station itself The corrections are given to the nearest second, an accuracy more than sufficient for this class of work The book can be recommended to those who find themselves obliged to use satellite stations frequently The tables can, as remarked in the foreword, be made use of for tacheometrical calculations

Introduction to Modern Physics By Prof F K Richtmyer (International Series in Physics) Second edition Pp xviii+747+6 plates (New York and London McGraw-Hill Book Co , Inc., 1934) 30*s* net

THE first edition of Prof Richtmyer's book has been appreciated by so many physicists that the appearance of a second edition is bound to be warmly welcomed, and it is only necessary here to note the chief changes which have been made An adequate outline of the application of Fermi-Dirac statistics to problems in photo electricity has been added and the chapter on X-rays brought up to date The chapter on the structure of the nucleus has been considerably altered in view of recent work on artificial disintegration, and the neutron and positron both find a place, though perhaps a small one in the case of the latter. Two very important new chapters have been included, one on the vector model of the atom and one on the wave theory of matter The first will be particularly helpful to students, and the latter properly completes a first-class introduction to modern physics

A Large French Wind Tunnel

THE large wind tunnel which has just been completed at Chalais-Meudon is of considerable interest It is the second tunnel capable of testing a full-sized aeroplane to be constructed, the first being the 60 ft 30 ft tunnel at Langley Field, U S A , and it differs in one very important respect from any other wind tunnel, in that it is built in the open In general design it is not unlike the tunnel built by Eiffel in 1912 at Auteuil , a type now generally known by his name Air is drawn in through a contracting inlet and then passes as a parallel free jet across the observation chamber into a collector cone in which a gradual expansion takes place in order to recover most of the kinetic energy of the stream

In the older Eiffel tunnels, an airscrew or a centrifugal fan at the end of this expansion cone drew the air through the tunnel, which was itself housed in a large room through which the air returned to the intake end at a low speed As a single airscrew in the present large tunnel would be of such great diameter, the expansion cone has been allowed to discharge into a large chamber, or 'diffusor', from which the air is extracted by six airscrews, each working in a short expansion cone projecting from the back wall of the chamber The cross-section of the tunnel is everywhere elliptical, and at the working section is 52 ft wide and 26 ft high Each of the six airscrews is driven by a 1,000 h p variable speed electric motor, and a maximum wind speed of about 110 miles per hour is expected As mentioned above, an entirely novel feature is that the tunnel is in the open, instead of being housed in a building, thereby effecting a very large saving in the cost of construction

The new tunnel differs radically from the full-scale tunnel at Langley Field, which is of the return-flow type in which the air leaving the driving airscrew is guided by suitable ducts of gradually expanding cross-section back to the intake end of the tunnel, a type first successfully used by Prof Prandtl at Gottingen Such a tunnel is more costly than one of the French type, as there is at least twice as much ducting, but it has the advantage that the air in the tunnel is quite free from external atmospheric disturbances The power consumption for a given wind speed is less in the return flow type , but, if the figures given for the French tunnel are realised, the difference is not very great and may well be counterbalanced by the lower constructional cost

The one debatable point about the new tunnel is the advisability of placing such a tunnel in the open air, where the incoming air is subject to atmospheric disturbances There is very little data on the effect such disturbances will have in a large high-speed tunnel Some experiments made on a small model of a wind tunnel at the National Physical Laboratory many years ago showed that the disturbances in the tunnel stream were many times as great when the tunnel was in the open, even when the wind outdoors was only a light breeze, than when it was operated in the still air of a large room This model was, however, very small, and was only operated at the comparatively low speed of 40 ft /sec , at which the dynamic pressure is comparable with the pressure changes occurring in a gusty wind of quite low velocity In the French tunnel the speed is much higher, and moreover, the inlet and outlet ends are separated by many hundreds of feet, a dimension which may be large compared with the average extent of eddies in the atmosphere It may be mentioned that the tunnel has been placed in a hollow, with the view of shielding it so far as possible, but even with this protection it seems unlikely that it will prove possible to use the tunnel satisfactorily if any considerable natural wind is blowing It will be exceedingly interesting to learn how the tunnel behaves in this respect, and what is the limiting natural wind velocity at which the tunnel stream is still steady enough for normal measurements

A great deal might be written on the relative merits of the large tunnel capable of testing actual aircraft, and the alternative of testing scale-models in smaller tunnels, with guidance on scale-effect obtained by researches in a compressed air tunnel There is certainly one field in which the large tunnel should be exceedingly useful In these days the most marked tendency of aircraft design is towards the reduction of resistance and the attainment of high speed For investigations with this end in view, the large tunnel offers the great advantage that the actual aircraft can be tested with all its little imperfections, such as roughness of surface and unavoidable excrescences, and that the effect of practicable improvements in such details can be directly determined In testing small models in normal wind tunnels or in the compressed air tunnel, there is a distinct danger that the finer detail of the actual machine may not be properly represented

The large tunnel also holds out the possibility of testing the aircraft with its engine and airscrew running, and so of investigating the effect of attempts to reduce resistance without adversely affecting engine cooling This class of experiment, which is of great importance, is practically impossible on small models, though it can be carried out in a smaller tunnel than the new French one The 20 ft tunnel in the United States and the new 24 ft tunnel at Farnborough were, in fact, built chiefly for such work The cost of running a full-scale tunnel, and of the preparation of machines for test therein, is necessarily heavy, and there is the limitation that even in such tunnels as those at Chalais-Meudon and Langley Field, only a small aeroplane can be tested The limit of span, without involving large corrections for the constraint of the limited stream, would probably be about 40 ft

In spite of such limitations—and every type of tunnel has limitations of some kind—the new equipment should prove of great value to the French in the study of aerodynamics, and it is to be hoped that results obtained by its use will be available to the world at large It is only by careful analysis and comparison of results obtained in various types of wind tunnel and on machines in flight that the greatest use can be made of the research work of the various institutions in different countries

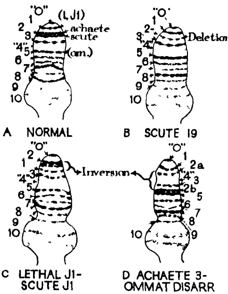
Minute Intergenic Rearrangement as a Cause of Apparent 'Gene Mutation'

By H J MULLER, A PROKOFYEVA and D RAFFEL, Institute of Genetics, Academy of Sciences of the U S S R, Moscow

WHEN it was discovered that chromosome breakage and reattachment usually entail effects resembling those of gene mutations located at or very near the point of breakage, it was suggested, as one alternative interpretation of this phenomenon, that the change in position of genes near the breakage point, with respect to other genes in their immediate vicinity, might in itself be the cause of their altered mode of reaction upon the organism (Muller, 1930) This was an extension of the 'position effect' principle which had previously been proposed for the special case of the bar genes, two of which had been found to have a greater effect when in the same chromosome than when in opposite chromosomes (Sturtevant, 1925) Since 1930, numerous further illustrations have been found, by various investigators, showing the comparative regularity with which effects resembling those of gene mutations in nearby loci accompany breaks, but there has been little or nothing in their evidence that would serve to test the probability of the 'position effect' interpretation as opposed to the alternative conception that the disturbance involved in the process of breakage was of such a nature as to be likely simultaneously to upset and alter (once for all) the inner composition of genes in the vicinity The senior author has now, however, obtained definitive evidence (see Muller and Prokofyeva, 1934) of the correctness of the 'position effect' interpretation, through the finding that different rearrangements involving the scute locus in *Drosophila* in the great majority of cases result in phenotypically different 'allelomorphs', whereas nearly identical rearrangements (scute 4 and scute *L8*) have given sensibly the same 'allelomorphs'

The general question thus arises, what proportion of apparent mutations are only intergenic 'position effects' rather than autonomous intragenic changes? Of twenty-seven scute and achaete mutations investigated which have been produced by irradiation, it has so far been possible to demonstrate in eighteen cases that there was a breakage and re-attachment close to the scute or achaete locus Some or all of the remainder also are probably intergenic rearrangements, for it has been found in this investigation that the rearrangements tend to fall into two categories, gross and minute, the latter being of such a nature that a genetic discrimination between them and true intragenic mutations would be very difficult, or in many cases even impossible

One example of a minute rearrangement is scute 19, in which only a fraction of a single chromomere (or chromatin 'ring' number 2, as seen in the salivary gland) has, as shown both by genetic and cytological evidence (see Fig 1), become deleted, by a break on each side of it within the same chromomere, and inserted into another region of the chromatin (within the right arm of chromosome 2) We accept here Koltzoff's explanation of the structure of the salivary gland chromosomes, as bundles of practically uncoiled chromonemata the adjacent chromomeres of which form the 'rings' or 'discs' (see also Carnoy, 1884, and Alverdes, 1912, 1913), our work, however, shows definitely that the genes—usually more than one per chromomere—are contained within these chromomeres Special genetic and cytological methods explained elsewhere have shown that the displaced section of the chromomere here in question includes only about six (four to eight) genes This case does not illustrate a method of origination of recognisable 'deficiencies' alone If such a deficiency included but one or two genes, instead of six, it would in some cases be viable and resemble in its heredity an intragenic mutation, as other work of Muller (in press) has shown On the other hand, the inserted section, without the deficiency, could be mistaken for a simple genic 'suppressor', especially since, having been weakened in its activity by the effect of its changed position, it could appear as a recessive (unlike most recessives, however, a duplication of the region in which it lay would not serve to counteract it). These changes might or might not be detectable cytologically, depending on their size. If, finally, instead of having been lost or inserted into another region, the minute section dealt with in the case of scute 19 had only been inverted, while remaining otherwise in its place, the change would not only have behaved genetically like a gene mutation, but also it would have been impossible of recognition as a rearrangement, even by the new cytological method.



A NORMAL B SCUTE 19

C LETHAL J1-SCUTE J1 D ACHAETE 3-OMMAT DISARR

FIG 1 Appearance of extreme left end of *X*-chromosome of *Drosophila melanogaster* as seen in the salivary gland, in normal material and in the case of three minute rearrangements. The exact or approximate () positions of the gene loci concerned are shown in the figure for the normal. All four drawings are from typical specimens and show only the terminal twentieth ($\frac{1}{20}$) of the entire active region of the *X*-chromosome.

The existence of minute inversions of the general type above mentioned was at first only an inference from the above and other cases of insertion, but soon actual proof of them was found. The first case in point was that of scute J1. Here cytological examination (see Fig 1) proved that an only slightly larger section than the above, involving only two chromomeres or 'rings', 1 and 2, had become inverted (*in situ*). This was precisely the result which the senior author had been led to expect on the basis of this mutation having involved the simultaneous alteration of the effects of two nearby loci: those of lethal J1, normally to the left, as proved by genetic analysis of chromosome fragments broken between the two loci, and of scute, normally to the right. The seeming 'double mutation' here, as probably in most other cases, was simply due to the two different position effects occurring at the two different (but nearby) points of breakage and reattachment.

Another case in which the genetic expectation of a minute inversion, based on 'double mutation', was similarly confirmed by the cytological finding, was that of achaete 3 (= scute 10). Here the mutation other than that at the achaete locus was the ommatidial disarrangement 'om', which was proved to lie slightly to the right of achaete by the same method of analysis of fragments as that used before (analysis by crossing-over being virtually precluded in this as in the other two cases by reason of the small distances involved). In correspondence with this genetic situation, it was found that one point of breakage and reattachment lay within chromomere (= 'ring') 2, near the point in this chromomere where previous cytogenetic analysis by Muller and Prokofyeva (1934) had shown the achaete gene to be, while the other point of breakage and reattachment lay just to the left of or just within chromomere (= 'ring') 5, the region between these two points of breakage being exactly inverted (see Fig 1).

Since double breaks and reattachments are not all thus accompanied by a *discernible* position effect in two demonstrably separate loci, this genetic criterion of a minute rearrangement is only sometimes provided. It is therefore evident that a minute inversion involving only a few genes (or sometimes only one gene ?) would often be not only cytologically but also genetically indistinguishable from an intragenic mutation, by any methods at present in use.

C. A. Offermann has directed our attention to the fact that there is evidence from another direction that a considerable proportion (if not all) of the apparent 'gene mutations' produced by X-rays are really the effects of changes in position caused by minute intergenic rearrangements. This evidence lies in the fact that the frequency of production by X-rays of readily demonstrable (gross) gene rearrangements is vastly greater in spermatozoa than in other cells, and that, corresponding with this, the frequency of production of apparent 'gene mutations' is also considerably raised in spermatozoa, as compared with other cells—although not nearly as much raised as is the gross rearrangement frequency (see Muller and Altenburg, 1930). Now exactly such relations are to be expected, if most of the induced 'gene mutations' are fine rearrangements, and if we accept the very probable hypothesis that rearrangements, like cross-overs, require contact between two chromonemata (or two portions of one chromonema). For the chromosomes are very much more crowded together and are more condensed in spermatozoa than in other cells. The much greater degree of crowding together would give vastly more chance for juxtaposition of parts that ordinarily lie widely separated, and so would lead to a far higher frequency of gross rearrangements, while the greater degree of condensation would give more chance for contacts on the part of the very fine loopings that would be responsible for the minute rearrangements

As our studies of mutations in the *X* and other chromosomes have shown that apparent replicas of practically all known 'natural mutations' in *Drosophila* may also be obtained by X-rays, the further question is raised as to what proportion of 'natural mutations' in *Drosophila* may really be minute rearrangements This question is of moment because the range of possibilities of phenotypic change through intergenic rearrangements alone must be far from adequate for any indefinitely continued evolution The latter must depend for the most part upon intragenic change, and hence it is important for the study of evolution, though at present seemingly so impossible, to be able to distinguish some at least of the intragenic mutations from the minute intergenic types of rearrangement The matter acquires a greater urgency for geneticists when it is realised that they may now expect to have to meet attacks from orthogeneticists and Lamarckians, who may see in the present uncertainty regarding the 'building blocks of evolution', an opportunity of reintroducing teleological notions of evolutionary causation

In this connexion, it must not be forgotten that all the cytogenetic investigations of species-crossing have agreed in showing that species differences in general reside in chromosomal differences and are therefore fundamentally *Mendelian* in their inheritance When the chromosomes in species-crosses are able to undergo reduction, the species differences show spread of variation and eventual return to either parent species, whereas, when chromosome segregation is prevented—whether by asexual reproduction, by division of chromosomes at both maturation divisions (as in butterfly hybrids), or by the somatic origination of allotetraploidy—the hybrids breed true Now Mendelian differences have been found to originate only by a sudden process—mutation Since mutations involving intergenic changes are necessarily inadequate to provide most of the material for species divergence, it logically follows that a part of the mutations must be intragenic It is only to be expected that many of these would be similar, in their phenotypic consequences, to effects of intergenic origin, and that discrimination between the two classes of change would present considerable difficulties Such discrimination must, however, be eventually attempted

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Obituary

SIR HORACE LAMB, F R S.

HORACE LAMB was born at Stockport in 1849 His childhood was passed mostly in a household where the strictness of the religious ideas prevailing at that time left little scope for his naturally happy nature and his great vitality These qualities, which so endeared him to his friends in later years, began to appear at school At Stockport Grammar School, he had the good fortune to come under a sound and kindly scholar named Hamilton, who quickly appreciated his merits, and finally sent him up to Cambridge, where in 1867 he gained a classical scholarship at Queens' College. At that time his allegiance was almost equally divided between classics and mathematics, but his visit to Cambridge, when he sat for the scholarship examination, turned the scale in favour of mathematics. On his return to Stockport he decided not to take up his classical scholarship but to sit for a mathematical one at Trinity in the following year. His interest in classics and literature, however, remained with him all his life, and had a profound influence on his children, all but one of whom turned to literature or art rather than to science

The year of preparation for the mathematical scholarship was spent at Owen's College, Manchester, where, under Prof Barker, Lamb first experienced the recondite joys of the higher mathematics. At Trinity, which he entered in 1868, he graduated as second wrangler, and was elected to a fellowship At that time, and for some years afterwards, Cambridge mathematics was dominated by the tripos examinations A young man's ability was judged entirely by his place in the tripos, and his competence as a mathematician by the ingenuity of the questions which he set when in due course he appeared as a tripos examiner. Among the more old-fashioned, it was considered rather pushing to publish original mathematical work. The proper way in which a lecturer could make known any theorem which he might discover in his teaching was to set it as a tripos question The science of hydrodynamics was at that time concerned almost entirely with an idealised, non-existent fluid which moved only in irrotational motion, without vorticity, and was thus well adapted for tripos questions.

Lamb, in his first course of lectures on hydrodynamics, given at Trinity in 1874, broke new ground when he gave an account of Helmholtz's great work on vortex motion. The substance of these lectures was published in 1878 as a "Treatise on the Motion of Fluids". This book, of some 250 pages, expanded in subsequent editions until as "Hydrodynamics" it covered some 700 pages. During its long career, which is still in full vigour, it has become the foundation on which nearly all subsequent workers in hydrodynamics have built. The long continued supremacy of this book in a field where much development has been taking place is very remarkable, and is evidence of the complete mastery which its author retained over this subject throughout his life.

It is of interest to notice through the various editions of "Hydrodynamics" the continually increasing stress which is laid on the physical side of hydrodynamics. In the first edition (1879), the mathematical consequences of the conception of an ideal fluid are systematised and generalised in a form which is æsthetically very satisfying, and special problems are treated mostly as exercises of the type which occur in the tripos. In subsequent editions, problems are treated more from the point of view of their intrinsic interest as illustrating natural phenomena or experimental conditions. Numerical values are given for results which at first appeared only in symbolical form. Motions such as turbulent flow, which even now defy exact mathematical treatment, are discussed, in the later editions, in the partial and incomplete forms which they had attained at the time of publication. New developments have been brought into the scheme of the book, and it is this continuous growth as an organic whole that has enabled Lamb's "Hydrodynamics" to be still, after fifty five years of life, the best book on the subject.

In 1875, Lamb married Miss Elizabeth Foot, the youngest sister of the wife of his old headmaster, and shortly afterwards he went out to Australia, where he had been appointed the first professor of mathematics and physics in the new University of Adelaide. Here he passed nine years, during which he established a laboratory and set the high tradition in science which Adelaide has preserved to this day. In spite of the cares of a large family, for three sons and three daughters were born while the Lamb family was in Australia, he published a remarkable series of papers on elastic and electric oscillations, and on hydrodynamics. These were all characterised by great clearness of expression, and they established his reputation as an applied mathematician so quickly and firmly that, at the earliest opportunity, which occurred in 1884, he was called back to England to the mathematical chair at Owen's College. At Manchester he threw himself into the work of the University and showed an aptitude for affairs which does not always accompany exceptional mathematical powers.

In his early days, Lamb was very fond of mountaineering, and he spent several seasons in the Alps. As soon as his children were old enough, he took them for long holidays walking in the Welsh hills or in Cumberland. Later he took them in turns to Italy, where he soon acquired a considerable knowledge of Italian art.

While in Manchester, Lamb spared no pains to make his lectures clear and well ordered. The text books which he published at that time bear witness to his care in that respect. At the same time, he made a number of important contributions to applied mathematics. The most noticeable characteristic of these works is the way in which the physical meaning of difficult analysis is clearly brought out. One of the most striking of Lamb's works published at this time is the complete analysis which he made in 1904 of the waves produced in an elastic solid by an impulse of short duration. He analysed the process by which a localised impulse can separate itself out into a number of disturbances of different types which travel at different speeds and therefore become separated. The seismological implications of this work have scarcely yet been fully discussed. Among other geophysical problems are the effect of vertical loading on the earth's surface (1917) and the waves in an atmosphere the temperature of which decreases with height (1910). This last paper must form the basis of any future attempt that may be made to calculate the tides in the atmosphere.

In 1920, Lamb retired from Manchester, and shortly afterwards returned to Cambridge, where his friend and colleague Lord Rutherford had just become the professor of physics. Trinity College made him an honorary fellow and he very frequently dined in hall, where his youthful nature made him very welcome to a company which included men nearly fifty years younger than himself.

At this time, Lamb's mind was much occupied with problems of aeronautical research. Until a few years ago, he was a member of the Aeronautical Research Committee, and when he retired from that body he still kept in touch with the more purely scientific side of its activities. Sometimes he helped with constructive criticism, sometimes he formulated aeronautical problems in a mathematical form, and sometimes he gave definite solutions of problems formulated by others. His services in this field were very much appreciated by those responsible for directing aeronautical research in Great Britain, and nowhere is his loss felt more deeply than among those whom he honoured by his kindly but telling criticism of their work.

In 1884, Lamb was elected to the Royal Society. He served three times on its Council and was twice a vice-president. In 1931, he was knighted. He was president of the British Association in 1925–26 and of its Section A in 1904. He died on December 4.

Lamb had three sons and four daughters. His eldest son, E. H. Lamb, is professor of engineering at Queen Mary College, London. The second, W. R. M. Lamb, is secretary of the Royal Academy and was formerly a fellow of Trinity. The youngest is Henry Lamb, an artist. One of his daughters is

Mrs. Palmer, now fellow and tutor of Newnham College, Cambridge. Another is Lady Brooke, wife of Sir J. R. Brooke, of the Electricity Commission.

This record of Sir Horace Lamb would be incomplete without referring to his sunny temperament and the vivid interest in every kind of human activity, which made him so fascinating a personality to all who had the good fortune to come into contact with him. G. I. T.

Dr. A. A. Belopolsky

Aristarch Apollonovitch Belopolsky, the well-known astrophysicist, member of the Russian Academy of Sciences since 1903, honorary director of the Pulkovo Astronomical Observatory in the U.S.S.R. and since 1910 an associate of the Royal Astronomical Society in London, passed away at Pulkovo on May 16, 1934, at the age of eighty years.

The main work of Belopolsky's long and laborious life was connected with spectroscopic investigations of the sun and stars. It was he who was charged in 1891 by F. A. Bredichine, then director of the Pulkovo Observatory, with planning the astrophysical equipment for use with the 30-in. refractor, visual at first and later for photographic records. His first observations were on Nova Aurigæ, in 1892, and since he never missed any new star, he accumulated a series of valuable spectrograms and obtained in some cases pure absorption spectra characteristic of the very first stages of the outbursts. At the same time, he made spectroscopic observations of the sun and was to the last president of the Solar Committee in the U.S.S.R. He was the first to determine, in 1915, the temperature of sunspots from his spectrograms.

In 1912 the Russian Academy of Sciences placed an order with the firm of Sir Howard Grubb, then in Dublin, for a big Littrow spectrograph, of 7-metre focal distance and a dispersion in the third order of 1 mm = 0.76 A. Owing to the War and succeeding adverse circumstances, the instrument did not reach Pulkovo until 1923, and Belopolsky immediately took up his part of the international research on the solar rotation.

Many beautiful records and classical discoveries testify to the knowledge and the experimental skill of Belopolsky. Thus, in 1894, he discovered the velocity variations of δ Cephei associated with the changes of light. Two years later he made the same discovery for η Aquilæ and in 1899 for ζ Geminorum. In 1895 he confirmed Keeler's discovery of the rotation law of the rings of Saturn. From his examination of the spectra of γ Virginis and γ Leonis he made an important advance in the determination of the parallaxes of double stars. His favourite star, however, was Polaris, and every second year he took up the determination of its elements. A very striking achievement was his experimental proof of the Doppler effect. Already in 1894 he had set up a device consisting of a series of rapidly rotating mirrors opposed to each other, thus making it possible to get very high speeds of the reflected ray of light. In 1898 the arrangement was ready and Belopolsky was able to confirm by a purely laboratory experiment a fundamental law of modern astrophysics.

To understand this remarkable gift in the application of physics to astronomy we have to go back to Belopolsky's education. His parents were well educated but poor, and they encouraged his intellectual ambitions. The boy revelled in natural sciences, made experiments at home in physics and chemistry, and was a craftsman, achieving good results with the simplest means and making instruments practically out of nothing. He studied at the University of Moscow and graduated in 1877. F. A. Bredichine was then at the head of the Moscow Observatory; he at once appreciated the gifts of the young man and made him his assistant. In 1888 Belopolsky went to the Pulkovo Observatory, where he stayed for the remainder of his life. He published his work on sunspots and their movement in 1886. From the beginning of the *Astrophysical Journal* in 1895, he took a great interest in the periodical and was one of its associate editors.

During his career at the University of Moscow, Belopolsky had to provide for himself and knew what hardship meant. But science had captured him and he never failed her, whether in good or in hard times. He was a very kind-hearted man, with a real sense of justice and truth.

Rev. T. E. Espin

We regret to record the death on December 2 of the Rev. T. H. E. C. Espin, the well known amateur astronomer. He began observing with a 1 in. telescope while at school at Haileybury, where his interest in the heavens was aroused by the appearance of Coggia's comet in 1872, and by his form master's lectures on his favourite hobby, astronomy.

On proceeding to Oxford, where he took his degree in 1881, Espin found his first double star with a 3-in. refractor, and evinced such enthusiasm that the Savilian professor allowed him the use of the University 13 in. At the age of twenty years he was elected a fellow of the Royal Astronomical Society, and soon afterwards was appointed special observer to the Liverpool Astronomical Society, of which he was a founder and president. At West Kirby, Wallasey and Wolsingham, where he was curate (1881–88) to his father, Chancellor Espin, a well-known ecclesiastical lawyer, he astonished the astronomical world by a survey of red stars, with a large reflecting telescope, of the whole of the northern heavens; he found 3,800, a total unequalled by any other observer. During this research more than thirty variables were discovered and observed until their range and period were determined. They included several remarkable objects, notably X Ophiuchi, V Cassiopeiae and R Canum Venat. At the same time he almost doubled the known number of type IV stars. In 1899 Mr. Espin began a micrometrical examination of all stars shown on Argelander's charts—a total of well over 300,000—for new double stars, and before his death had found 2,575. For these researches, extending over forty years, and for the discovery of Nova Lacertae, he received the

Jackson-Gwilt medal of the Royal Astronomical Society.

Mr. Espin invented a spectroscope, a variable-power eyepiece and Espin's star detector. On Röntgen's discovery of X rays, he built several high tension machines, culminating in a huge 24-plate Wimshurst, with which for many years he treated invalids from all over the country. In recent years, with the collaboration of W. Milburn, his astronomical assistant, he investigated the radioactivity of local spring waters and published the results in his observatory circular for 1933.

During the later years of his life, when he was unable to spend long hours in the observatory, Espin made and examined rock sections from his specimens collected abroad, especially of those from Vesuvius, Etna and Les Puys de Dôme. His scientific interests were thus very wide, and he brought both observation and thought to bear on many objects upon the earth as well as in the heavens. There are now few natural philosophers of his type, and his death has deprived the world of one who contributed much to its knowledge.

* * *

Mr. **Ernest Binfield Havell**, whose death at the age of seventy-three years occurred on December 30, was well known as one of the foremost authorities on Indian art, architecture and technology. He first went to India as superintendent of the Madras School of Art, and in 1896 was transferred to the Calcutta School, retiring from the Education Service in 1908. While at Calcutta he founded what has since come to be known as the Calcutta school of painting, and it was largely owing to his interest in indigenous industries that the village hand-loom industry was revived. An intense and enthusiastic appreciation of the aims of Indian art, especially of the Mogul and Rajput schools, was the basis of his conviction that the only future possible for a living school of art in India lay in an evolutionary development of the indigenous art, free from the influence of European ideals and methods. The enthusiastic welcome and support his views received from the Nationalist party in India proved an embarrassment rather than an assistance when, after his retirement, he endeavoured to promote in England a better understanding of India's artistic achievement. Mr. Havell was a voluminous writer on Indian art and technology, his best known work being a "Handbook of Indian Art" (1920).

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We regret to announce the following deaths:

Mr. H. G. Ponting, the official photographer to the Scott Expedition of 1910–13 to the South Pole, on February 7, aged sixty-four years.

Prof. Arthur Thomson, emeritus Dr. Lee's professor of anatomy in the University of Oxford, president of the Anatomical Society of Great Britain and Ireland in 1906, on February 7, aged seventy-six years.

News and Views

Ethnographical Films

Considerable interest has been aroused by a recent announcement that the Trustees of the British Museum have accepted the donation of a cinematograph film of the life of the Worora tribe of the Kimberley district of north-west Australia. The film was presented by Mr. H. R. Balfour of Melbourne. It was taken on the Government Native Reserve of Kunmunya, and shows the present conditions of native life. Technological processes, such as the making of stone axes and spear heads, in which these people are specially skilled, the making of fire by twirling one stick on another, the spinning of human hair for thread and the like are shown as living crafts. The 'shots' also include ceremonies and dances and an emu corroboree. The film has already been shown to missionaries, learned societies and medical students in Australia; but as is explained by Sir George Hill in a letter to *The Times* of February 7, owing to the fact that it was taken on a Government reserve, under the regulations of the Commonwealth Government, it cannot be shown commercially. With the permission of the Trustees of the Museum, arrangements have been made for the film to be shown at a meeting of the Royal Anthropological Institute to be held on March 19 at the London School of Hygiene and Tropical Medicine, but only fellows of the Institute and their guests can be admitted. A description of the film has been supplied by the Rev. J. R. B. Love, who is superintendent of the reserve and is well acquainted with the language of the Worora.

Although this film will, no doubt, prove of the greatest interest as an ethnographical record, it is by no means unique. The cinematograph camera has long been used as an adjunct to ethnographical exploration. One of the earliest records of this kind was the series taken by Prof. C. G. Seligman when a member of the Cooke Daniels–Seligman expedition to New Guinea thirty years ago, which was shown at the Leicester meeting of the British Association in 1907; and the late Sir Baldwin Spencer showed a detailed record of the life and corroborees of the natives of northern Australia at a meeting of the Royal Anthropological Institute in 1914. The diffidence felt by the Trustees of the British Museum in accepting the gift, notwithstanding the fact that it was a 'non-flam' film, has directed attention to the fact that the British Museum possesses one other film only, and that there is no official collection in Britain of these extremely valuable records of the life of primitive peoples, now rapidly passing away.

The possibility of forming such a collection or repository was one of a number of points connected with the making, selection and preservation of cinematograph films of anthropological and ethnographical interest, which was referred to a special committee appointed by the recent International Congress of Anthropological Sciences held in London in August last The committee is international in its composition, Great Britain being represented by Capt T A Joyce of the British Museum The matter, however, is not to be allowed to rest there so far as Great Britain is concerned, and it is announced in the February issue of *Man* that the British Film Institute has established a Scientific Research Panel of its Advisory Council, of which Prof J L Myres will act as chairman, to collect information as to the extent to which the cinematograph has been used in scientific work, details of methods and difficulties in technique, and particulars of films of scientific interest which have not been put into circulation through the ordinary commercial channels The Panel will welcome information on any of these points, communications should be addressed to the Secretary, British Film Institute, 4 Great Russell Street, London, W 1

City and Guilds (Engineering) College, London

IN speaking, at the jubilee celebration of the City and Guilds (Engineering) College, Prof H E Armstrong directed special attention to the origin of the Imperial College, tracing this and the general development of scientific activity at South Kensington mainly back to the late Lord Playfair, in particular to his appointment at the Museum of Practical Geology, the home of the Geological Survey, about 1843 South Kensington, he believes, is still without any memorial of the great 'little' man Discussing the history of the Royal College of Chemistry, established in Oxford Street in 1845, now the Royal College of Science, Prof Armstrong said that the funds were chiefly obtained from the farming community, owing to the enthusiasm aroused by Liebig in his tour throughout agricultural England in 1842–43 When the Royal College of Science was opened, its rural promoters had looked forward to the development of the school in the interests of agriculture Man may propose but professors dispose nothing was further from Hofmann's genius Agricultural chemistry, Prof Armstrong said, is not taught in England in a way in the least comparable with that in which engineering has been taught in the Guilds Colleges. He ventured to express the hope that, by the time the College of Chemistry celebrated its centenary, it will have learnt what its original purpose was and will seek to fulfil this By that time perhaps the world will have recognised that no other subject is so worthy of chief attention as is agriculture

SPEAKING of his work at the Central, after referring to the importance attached both there and at the Finsbury College to engineering as a necessary subject in the chemist's course, Prof. Armstrong said of the engineer: "I made no attempt to teach him chemistry: that I soon found to be impossible. I tried to teach him through simple acts of chemical inquiry, to experiment with a purpose, to observe accurately. above all to describe his work in lucid English: to take notes, in short, the hardest task of all My schoolmastering was not popular with many, at the time In after years I have had my full reward, as not a few have told me that my insistence on their learning to help themselves has been of special value to them" He ended by saying "At this, perhaps the most critical and solemn moment of my life, in the interests of our national engineering efficiency, I would plead for the recovery of the original spirit and a reconstitution of the College as a separate entity"

Sir Alfred Ewing and Seismometry

DR C DAVISON writes "During the five years (1878–83) that Ewing spent in Japan, like other English teachers in Tokyo he was infected by the enthusiasm of Prof John Milne, and became one of the first members, and afterwards a vice-president, of the Seismological Society of Japan founded by Milne in 1880 At one of the early meetings of the Society in that year, Ewing described his seismograph for horizontal motion, in which he preceded Rebeur Paschwitz in devising a horizontal pendulum with two fixed supports In 1881, he followed with an account of a seismometer for vertical motion, this, with the preceding, forming the well known instrument made by the Cambridge Instrument Co, Ltd In the following year, he devised his duplex pendulum seismometer The horizontal pendulum was erected in the Engineering Laboratory of the University of Tokyo in November 1880, and, at several later meetings of the Seismological Society, he exhibited the diagrams obtained with it The interest aroused by these early accurate records of the movements of the ground during an earthquake can be readily imagined Shortly before he left Japan, Ewing wrote his great memoir on 'Earthquake Measurement', in which he described the various forms of known seismographs and their underlying principles (*Tokyo Univ Sci Dept Mems*, No 9, 1883) Soon after this, his active interest in seismometry seems to have ceased, for, after his return to Great Britain, he made only one new contribution, that on seismometric measurements of the vibrations of the Tay Bridge during the passing of railway trains (*Roy Soc Proc*, **44**, 394–402, 1888) In these experiments made with a duplex pendulum seismometer, he showed that the greatest lateral and longitudinal movements of the bridge were about $\frac{1}{10}$ in and $\frac{1}{40}$ in respectively"

Research Laboratory at the National Gallery

TOWARDS the end of 1934, the Trustees of the National Gallery approved a scheme for the establishment of a laboratory to undertake the physical examination of pictures by means of X-rays, ultra violet and infra-red radiations, and by micrographic methods They also appointed a committee, consisting of Sir Henry Lyons, Sir William Bragg, and Dr. H J. Plenderleith, to act as an advisory body, should need arise: the laboratory is in charge of Mr. F. I. G Rawlins A considerable amount of the plant has already been installed, and work has begun with photomicrographic investigations, and to some extent with ultra-violet light. At the present rate of progress it is expected that the laboratory will be fully equipped by the end of April. The X-ray apparatus will contain several novel features. In addition, a number of ancillary researches are being initiated, including the microscopical examination of woods used for panels: it is hoped that this inquiry will produce valuable data for making the description of works in future editions of the catalogue more exact, as well as being a help in the question of attribution.

Large Sunspot Group

A MODERATELY large sunspot group which formed on February 5 has attracted, for its size, an undue amount of notice in the daily Press. The group occupies about 800 millionths of the sun's hemisphere, and a spot of these dimensions will be no uncommon occurrence during the next six or seven years, as the sunspot cycle passes through its maximum in 1938. Actually, a larger group, occupying 1000 millionths of the sun's hemisphere, has already appeared since the last minimum in 1933. This group had its central meridian passage on April 21·9, 1934 (see the *Observatory* for February 1935, where an account of 1934 sunspot activities will be found). The present spot is, however, not without interest. No spot was detected on a photograph exposed at Greenwich on February 5 at 10^h, but at 11^h a spectroscopic disturbance was *seen* in the spectrohelioscope, which seems to have been the genesis of the actual spot. On account of cloud, no photoheliogram was taken on February 6, and the spot appeared fully developed on February 7. The spot's latitude is 14° S., and it was born west of the central meridian. Its central meridian passage—if it survives—will take place on March 14 next. The spot is of such a size that it could just be seen by the naked eye if it was on the central meridian. Near the limb, where the spot appears foreshortened, a spot of this size would be invisible. It is interesting to note that the number of naked eye sunspots per annum follows the ordinary sunspot curve very closely, and that the 11-year cycle could well have been discovered by an observer provided only with a smoked glass—and a good climate.

Natural and Artificial Clouds

IN his Friday evening discourse at the Royal Institution on February 8, Sir Gilbert Walker discussed natural and artificial clouds. Apart from cumulus clouds of various types, the causes of the geometrical patterns that are to be seen in the sky must be sought in the behaviour of layers of fluid which are made unstable either by heating them from below or cooling them from above. It has been known for fifteen years that a stationary liquid when unstable develops a polygonal pattern, and that an unstable liquid flowing down a trough forms pairs of vortices rotating in opposite directions, with their axes parallel to the direction of flow, or of shear. Sir Gilbert's pupils have carried these investigations further, and A. Graham used a wind tunnel formed with a heated iron plate as lower surface; its upper surface was a cool glass strip 8 ft. long and 9 in. wide, a third of an inch above the iron plate. When pulled by a motor, this gave variable rates of shear in the air. The former explanation of clouds occurring in long rolls or in a rectangular pattern as caused by Helmholtz waves was shown to be unsatisfactory, and it was verified that while a rapid shear due to motion exceeding one inch a second produces longitudinal cells, one less than a fifth of that rate leads to transverse cells, and an intermediate rate to a rectangular pattern. Various types of longitudinal clouds were discussed, and Sir Gilbert withdrew his former explanation of spirals in these clouds as due to stream lines, showing that there are normally two equidistant spirals like those in a twistdrill, and that these appear to be the two component vortices intertwined. Photographs of clouds were used to demonstrate the formation of a number of patterns of clouds at different heights, and an account was given of the explanation suggested by A. Graham of the paradox that, in the laboratory, liquid rises in the axis of a cell while in air there is descent there. Attention was also directed to the existence of clouds due to instability or the sun, and to the use of clouds of longitudinal and rectangular patterns for long-distance gliding under the name of 'cloud-streets'.

Structure of the Universe

SPEAKING to the Durham University Philosophical Society on February 1 at Armstrong College, Newcastle-upon-Tyne, Dr. Herbert Dingle, assistant professor of astrophysics at the Imperial College of Science and Technology, gave a historical account of the development of our ideas of the structure of the universe. Defining the 'universe' as the whole of physical existence, he pointed out that this apparently general subject demands a treatment which is in many respects unique. The idea of infinity became general with the Renaissance, and this seemed to place the conception of the whole universe beyond the power of the finite mind, until Newton restored the possibility with his implicit concept of universal law which was everywhere applicable. There have been two criticisms of this, a valid objection, that this extension of locally derived law may be incorrect, and an invalid one, based on our imperfect knowledge of atomic processes, which ignores the fact that the laws of a whole can be arrived at without combining the laws of elementary parts. Towards the end of last century, it was argued that the Newtonian law of gravitation was inconsistent with an infinite extension of uniformly distributed matter, of however low a density. Relativity theory, however, made such homogeneity acceptable. The Einstein, de Sitter and expanding universes are widely known nowadays, but Dr. Dingle made it clear that there is nothing esoteric about such theories, and that their underlying principles might have been expected from recent observations even if they had not been discovered when they were. It was stated also that there is no objection to belief in an infinite space, if one is willing to admit that in Einstein's space-time it may be quite beyond physical exploration.

The Uncertainty Principle

IN a lecture delivered to the Physical and Chemical Society of University College, Nottingham, on February 4, Prof. E. Schrödinger directed attention to the difficulties and contradictions which arise from attempts to unite quantum theory with geometry and with the theory of relativity. Although the first researches on wave mechanics used the relativity ideas, they are really in flat contradiction to them. The theory of relativity supposes that rods and clocks can be used to measure exact lengths and times, and that in some way velocities can also be measured accurately. Unfortunately, Heisenberg's uncertainty principle, which appears to be inherent in quantum mechanics, lays down that simultaneous accurate measurements of position and velocity are impossible. Moreover, the regulation of a clock is not possible to more than a limited degree of accuracy, except when the clock is infinitely heavy. Similar considerations forbid us to apply our ideas of Euclidean geometry, based upon ideal rigid measuring rods, to small physical regions. Physicists have at least as much confidence in the special theory of relativity as in quantum theory; the problem of devising a unified theory appears to be still unsolved.

A French Chemical News Service

WE have before us the first number of *Les Nouvelles de la Chimie*—a new monthly paper issued in Paris. It resembles in its general appearance a daily paper, a fact which may seem unusual in England; in France there exist already several medical news journals having the same format. The front page of the new journal contains news items, interviews and similar topical material; on the second page we find a review of general scientific activities in the universities and laboratories, while the third and fourth pages are devoted to general technical and economic information. The editor of the new paper is M. Jean Gérard, the active director of the Maison de la Chimie and its Centre of Documentation. We understand that if the new venture fulfils the expectations of its promoters, it will develop into a weekly and finally into a daily news service covering not only the field of chemistry but also that of science in general.

Baffin Island Survey

THE annual report of the Canadian Department of Marine for the fiscal year 1933–34 contains some interesting information respecting the operations of the Canadian Hydrographic Service during the period under review. Among other technical observations, the Service carried out a survey of the Baffin Island coast, of which the following extract is a partial description. "In aspect, the south-eastern coast of Baffin Island is very bleak, bare rugged hills of gneiss and granite rising to elevations about 600 feet close to the sea and to greater heights inland. The ragged shore is broken by numerous fiord-like inlets, but from Pritzler Harbour to Barrier Inlet, 45 miles north-northwestward, the shore is fronted by many islets, rocks and shoals of a most dangerous character. The 50 fathoms contour, which lies at an average distance of 3 miles off the islands, should be considered the danger line. The country is quite uninhabited except for some Eskimos who travel gregariously along the coast in whaleboats (omiaks). These natives appear to be of a very good type—healthy, honest and well adapted to the rigours of the country. Their habitat is both the north and south coasts of the long peninsula which separates Frobisher bay from Hudson strait. The small, swift rivers which flow into the heads of the inlets are well stocked with a fine species of salmon trout weighing up to 8 lbs.; this food, together with seal, constitutes their chief diet. At certain times a caribou hunt takes place and the hunters travel inland for several days to secure fresh meat. In addition, the country also provides aquatic fowl, ptarmigan, arctic hare and an occasional walrus or polar bear."

Reversing Falls at Barrier Inlet

AFTER recording the absence of good ship harbourage between Pritzler Harbour and Barrier Inlet, the report of the Canadian Department of Marine goes on to describe the physical features of the latter, which is an arm of the sea extending 12 miles inland. At the entrance, it has a width of about a mile and a half, but two miles inside, the width contracts to three quarters of a mile. The channel is still further constricted at this point by a number of rocky islets, connected at low stages of the tide and leaving only two narrow passage-ways less than a hundred yards wide. "The free flow of the tide in and out of the inlet being thus constricted at the narrows, a 'head' of water is formed and creates a reversing falls. At the time of low tide on October 1, there was a sheer outward waterfall 8½ feet in height, and the lowering of the fiordal waters continued for a space of 2½ hours whilst the tide was rising outside at the foot of the cataract. Slack water occurred for a few moments when the flood tide reached the elevation of the water in the fiord but almost immediately the inward rush of water formed whirl pools and great eddies and soon waves, 6 feet high, careened wildly from side to side. A boat attempting to pass through at such time would be engulfed."

American Museum of Natural History: New Director

ACCORDING to *Science* of January 15, Dr. George H. Sherwood has resigned his post as director of the American Museum of Natural History to give his entire time to the School Service Section as curator-in-chief of education. Dr. Sherwood will remain honorary director of the museum. Dr. Roy Chapman Andrews will succeed Dr. Sherwood as the active head of the museum. As leader of the Central Asiatic Expeditions of the American Museum of Natural History, Dr. Andrews took his first expedition into the field in 1916 to work in the territory of Tibet, South-west China and Burma. His second expedition went into North China and Outer Mongolia in 1919, and the third expedition has worked in Central Asia, especially in Mongolia, since 1921, where it uncovered some of the richest fossil fields in the world. Dr. Andrews was awarded the Elisha Kent Kane Gold Medal of the Philadelphia Geographical Society, previously given to only eight explorers. Brown University and Beloit College have both conferred on him the degree of honorary doctor of science. He has been given the Hubbard Medal of the National Geographic Society in recognition of his discoveries in Asia. He is well known as a lecturer and author of popular books and articles on the results of his various expeditions, including a large volume covering his entire field work in Mongolia and China up to the present time entitled "The New Conquest of Central Asia".

Organisation of Museums

THE Madrid Conference on Museography on October 28–November 1, 1934, attended by seventy five experts representing twenty different countries, was noteworthy for the publicity it gave to the organic life led by museums outside their actual exhibition galleries, quite as much as for the success of the Conference in paving the way for a general treatise on the principles and practice of museums. The main object of this Conference, organised by the International Museums Office and the International Institute of Intellectual Co-operation, was to collect observations and the results of actual experience from as large a number of museums and countries as possible, rather than the formulation of general rules. The agenda of the Conference included discussions on the general principles of the architecture of a museum, on museum equipment both in exhibition and other public rooms and in the museum services; on lighting, heating, ventilation and air-conditioning; the conversion of ancient monuments and other buildings into museums; general principles regarding the enhancement of works of art; methods of presenting collections; organisation of stores, reserves and study collections; permanent and temporary exhibitions; problems arising from the growth of collections; exhibition material; plans of rooms and the numbering and labelling of exhibits. A number of special questions such as collections of sculpture, decorative and industrial art, folk-art and ethnography, and graphic and numismatic collections were also discussed. The Academy of Fine Arts, Madrid, was specially fitted up for the Conference by the Spanish Government, and the International Museums Office lent a considerable amount of graphic and photographic documents to illustrate the papers.

Electric Discharge Lamps for Road Lighting

IN many of the long stretches of main roads between towns and villages the only practical way of lighting at present seems to be by means of the lamps on the vehicles. In a paper on "Electric Discharge Lamps and Road Lighting" read to the Institution of Automobile Engineers on December 11, Mr. H. Warren and Mr. L. J. Davies show how the length of the permanent illumination of roads can be extended, with acceptable economy, by means of the new discharge lamps, when care is taken to distribute the light scientifically by means of suitable lanterns. Controlling the reflective properties of the road surfaces has also to be taken into consideration. With mercury and sodium vapours we have two substances which, when excited in the correct way, produce a sufficient proportion of energy in the visible spectrum to give a two- or three-fold increase in efficiency over incandescent lamps. A fifty fold efficiency is theoretically possible, but the practical utilisation of electrical discharges has just made a beginning. At present, electric discharge lamps for street lighting are of two main types, high-pressure mercury vapour and sodium vapour. The former type of lamp is most favoured in Great Britain, while on the Continent and in America the sodium vapour lamp is most used. Mercury discharge lamps have an excellent 'luminous output' during their lives, which are longer than those of other forms of lamp. The colour of the lamp, when viewed directly, is greenish-white. In the colours radiated, blue, green and yellow predominate, but red is practically lacking. By incorporating cadmium with the mercury a satisfactory red tinge can be introduced, but at a slightly lower efficiency. The colour correction of these lamps is receiving a great deal of attention in commercial research laboratories at present.

Continuously Evacuated Radio Transmitting Valves

AT the meeting of the Wireless Section of the Institution of Electrical Engineers on February 6, a paper entitled "Continuously Evacuated Valves and their Associated Equipment" was read by Mr. C. R. Burch and Dr. C. Sykes. This paper describes the development of demountable thermionic transmitting valves of various power ratings, the valves being evacuated continuously by means of oil condensation pumps. This work has arisen out of some experiments carried out in 1929 on the distillation of lubricating oil in a molecular still. It was found that one of the fractions was about a thousand times less volatile than mercury, so that if such a liquid could be used as the working fluid in a condensation pump, a vacuum of the order of 10^{-6} mm should be attainable without the use of liquid air or other refrigerants; and such a vacuum is quite adequate for valve exhaustion. These expectations have been fully realised in the development of oil-condensation pumps which will work against a fore-vacuum of 0·05 mm. and will produce a vacuum of 10^{-3}-10^{-6} mm. at a speed of 20 litres per second. Such pumping equipment is described in the paper in some detail, and reference is made to its application to the production of thermionic valves of a power rating ranging from 20 kw. to 500 kw. for high-frequency furnaces and for radio transmitting stations. Several valves of the 30 kw. order have been in use on commercial radio traffic at the Post Office station at Rugby for long periods, and they have given satisfactory service. A 500 kw. valve is in the stage of experimental trial on the long-wave transmitter at Rugby. The relative merits of these valves and those of the sealed-off type were discussed briefly in the paper, and were enlarged upon by several speakers in the discussion which followed the reading of the paper.

Deep-Sea Observations with the Bathysphere

FOUR years ago, Dr. William Beebe and Mr. Otis Barton descended in their 'bathysphere'—a steel ball fitted with quartz windows—to a depth of a quarter of a mile below the surface of the ocean off Bermuda. During the season of 1934 they successfully established a new depth record of 3,028 ft. In the *National Geographic Magazine* of December 1934 and the *Bulletin of the New York Zoological Society* of November–December 1934, interesting articles deal with the fitting-out, operation and scientific observations made during these latest dives. Excellent photographs in the text provide a word picture of the undertaking, and a series of coloured plates give vivid impressions of the strange and bizarre forms of life as seen by Dr. Beebe through the windows of the ball and described over the telephone line between the bathysphere below and the parent ship at the surface. Three deep sea fish, new to science, are described, including the five lined constellation fish, *Bathysidus pentagrammus*, which Dr. Beebe speaks of as one of the most gorgeous deep-sea inhabitants he has ever seen. Five rows of photophores emitting yellow and purple light produced a beautiful pattern of illumination through the darkness. From this and other records, there can be little doubt as to the success and scientific value of this daring method of observation.

Optical Research

AT the meetings of the Institut d'Optique, held periodically at the Sorbonne and generally under the chairmanship of Prof. Charles Fabry, director of the Institut, the communications considered relate as a rule to one particular branch of the subject, and the *Revue d'Optique Theorique et Instrumentale* issues a separate copy of the proceedings which may run to as much as 50 pages. Last year, the January meeting dealt with the employment of liquid prisms in spectrographs, that of March with interference methods of studying movements of the air, the April meeting with ultra-violet polarimetry and with the densities of photographic images, and the June meeting with the light of the night sky. In several cases the subject is introduced by a short sketch of past work on it and its present aims and problems, given by the president, and descriptions of current methods and instruments by specialists in the subject follow. These pamphlets seem capable of affording great assistance to those requiring brief résumés of the present positions of the various branches of optical research.

Systematics of the Diptera

MR. P. H. GRIMSHAW has recently published a useful article entitled "Introduction to the Study of Diptera, with a Key for the Identification of Families" (*Proc. Roy. Phys. Soc., Edin.*, **22**, Pt. 4, July 1934). The paper gives a clear account, accompanied by illustrations, of the various structural features of importance in classification. A list of the chief general works on the order is provided and a diagnostic key to all the existing families. The key is translated and adapted from Lindner's "Fliegen der palaeartischen Region" and should prove especially valuable to those entomologists who are not specialists in the insect order concerned.

Review of Seismology

THE National Research Council of the National Academy of Sciences at Washington is issuing a series of bulletins on the physics of the earth, to give scientific workers who are not specialists in the subjects treated an idea of the position and problems of various branches of geophysics. Among the bulletins in this series which have already been issued are those on volcanology, the figure of the earth, meteorology, the age of the earth and oceanography. Recently, Bulletin No. 90 on seismology has appeared. It has been prepared by a Committee of which Prof. J. B. Macelwane is chairman. Within 219 pages it includes twenty chapters, and gives a very valuable and interesting general view of the subject. Chapters by the chairman include—the definition and classification of earthquakes, tectonic earthquakes, plutonic earthquakes, rock fall earthquakes, body waves, reflection and refraction of seismic waves, surface waves and paths and velocities of seismic waves within the earth; H. O. Woods contributes articles on volcanic earthquakes, field investigation and surface geology in relation to the 'apparent' intensity; articles by H. F. Reid deal with magnetic effects, earthquake mechanics and with the focus. The principle of the seismograph is described by J. A. Anderson, and P. Byerly contributes five articles on analysis of seismograms in earthquakes, records at intermediate and great distances, time distance curves, reduction of trace amplitude, and seismic geography. The Bulletin has numerous bibliographies and is priced at 2 dollars.

Books on Anthropology and Archæology

CATALOGUE No. 574 (Anthropology and Folklore—Archæology and Ethnography) issued by Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, London, W.1, including both new and second-hand books, though, naturally, the latter predominate, contains just under a thousand items. On looking through the list, two points occur, one being the high average in the quality of the books from the point of view of the anthropologist, and secondly the fact that, with certain exceptions, the prices do not rule high. With regard to the first point, the subjects covered by the catalogue, it is almost needless to say, have been a happy hunting ground for the wilder theorist and speculation has been rife in their literature. It is evident that here on the whole a wide discretion has been exercised in selection. The question of price is no less interesting. It is not intended to convey that this catalogue is an exceptional opportunity for bargain hunters—although it would be possible to form from its pages an excellent nucleus of a reference library in anthropology at a very moderate price—but rather that the rarities, and even some of the older standard books which command a high price, are becoming increasingly rare. Among the items to be noted are some complete runs of scientific publications, such as the Folklore Society's publications and those of the Royal Anthropological Institute, some lengthy runs of *Archæologia* and a virtually complete set of the *Journal of the African Society*, of which certain numbers are now impossible to obtain, except by fortunate accident A noteworthy item is Edge Partington's ethnographic album of the Pacific, of which, it is thought, not more than half a dozen copies are now in existence in private hands

Announcements

THE following have recently been elected foreign members of the Royal Academy of Sciences, Stockholm Prof Robert Robinson, professor of chemistry in the University of Oxford, Prof F D. Adams, emeritus Logan professor of geology in the McGill University, Montreal, Prof Ejnar Hertzsprung, professor of astrophysics in the University of Leyden, Holland, and Prof A V Hill, Foulerton research professor of the Royal Society, formerly Jodrell professor of physiology in University College, London

AT the annual general meeting of the Royal Astronomical Society held on February 8, the following officers were elected *President:* Mr J H Reynolds, *Vice-Presidents:* Prof S. Chapman, Dr H. Spencer Jones, Dr H Knox-Shaw, Prof F J M Stratton, *Treasurer* Sir Frank W Dyson, *Secretaries*. Mr W M H Greaves and Dr W M Smart, *Foreign Secretary* Prof Alfred Fowler

MR B H WILSDON has been appointed to the post of director of research to the Wool Industries Research Association at Torridon, Headingley, Leeds Since 1929, Mr Wilsdon has been assistant director and superintendent of the Building Research Station of the Department of Scientific and Industrial Research He was educated at Lincoln College, Oxford, and after a period of research there, went to India as a professor of chemistry, afterwards gaining varied experience in applied research in agriculture and organising the Irrigation Research Institute of the Punjab Besides publishing work on chemical and physical subjects, Mr Wilsdon has done pioneer work on the application of statistical methods to industrial problems of specification and standardisation

IN NATURE of February 9 (p 212), it was stated, following the Report for 1933–34 of the Department of Scientific and Industrial Research, that the new process of the Wool Industries Research Association for the production of unshrinkable fabrics is being exploited under mill conditions and that materials should be available to the public early this year. We are informed by the Association that work still remains to be done on the problems which occur in transferring the operation of such a process from the laboratory to a commercial scale, and that "it is certain that underwear or other knitted materials, finished by application of the W.I R A.'s new unshrinkable process, will not be available to the Trade before 1936"

THE Secretary of State for the Colonies has made the following appointments Mr R M Gambles, to be veterinary officer, Cyprus, Mr. J. D. Tallantire, to be superintendent of agriculture, Nigeria; Mr J M S Usher-Wilson, to be superintendent of agriculture, Nigeria, Mr R L Brooks (deputy conservator of forests), to be conservator of forests, Trinidad, Mr P E Carcenac (assistant conservator of forests, Mauritius), to be assistant conservator of forests, Malaya, Mr J de Meza (veterinary bacteriologist), to be chief veterinary officer, Nyasaland, Mr J C Muir (superintendent of agriculture, Gold Coast), to be senior agricultural officer, Zanzibar, Mr F B L Butler (grader and inspector, Agricultural Department, Kenya), to be chief grader and inspector of produce, Agricultural Department, Cyprus

THE twenty-fifth Dutch Congress of Natural Science and Medicine will be held in Leyden on April 23–25 under the presidency of Prof J van der Hoeve with Prof L G. M Baas Becking as president of the biological section and Prof E Gorter as president of the medical section Further information can be obtained from the general secretaries, Dr D. Coelingh, Regentesslaan 2, and D. N R. Pekelharing, Jr, Meentweg 48, Bussum.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Probationer mapping assistants to H M Land Registry—The Secretary, Civil Service Commission, Burlington Gardens, London, W 1 (Feb. 21) A head of the Engineering Department of the Willesden Technical College—The Secretary, H M Walton (T), 10 Great George Street, Westminster, S W 1 (Feb. 22) A lecturer in electrical engineering at Norwich Technical College—The Principal (Feb 25) A lecturer in electrical engineering at Chesterfield Technical College—The Director of Education, County Education Office, St Mary's Gate, Derby (Feb 25) A computer (Class II, male or female) for the Ordnance Committee, Royal Arsenal, Woolwich, S E 18—The Secretary (Feb 25) A principal of the South-East Essex Technical College—The Director of Education, County Offices, Chelmsford (Feb 28). A lecturer in pathology in the University of Bristol—The Registrar (March 1) A lecturer in bacteriology in the University of Manchester and assistant bacteriologist in the Public Health Laboratory—The Secretary, University, Birmingham 3 (March 1) Junior scientific officers at the National Physical Laboratory to work in the Aerodynamics and Radio Departments—The Director (March 4) Probationary assistant engineers in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 7) A lecturer in anatomy and deputy-director of the Department at St. Thomas's Hospital Medical School, Lambeth Palace Road, London, S E 1 (March 16) Laboratory assistants (male) at the Experimental Station, Porton, near Salisbury—The Commandant.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 271

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Viscosity of Helium I and Helium II

DETERMINATIONS have recently been made in the Cryogenic Laboratory at Toronto of the viscosity of liquid helium in its two states, helium I and helium II

Helium I denotes the liquid as it first forms at a temperature of 4·2° K When the pressure above the liquid is progressively reduced, the temperature falls and the liquid bubbles freely as it boils under the reduced pressure Suddenly, when a temperature of 2·2° K is reached, the liquid changes its state—a change indicated by complete cessation of boiling, although the temperature continues to fall as pumping is continued.

The viscosity of liquid helium was measured, step by step as the temperature was reduced, by means of observation of the logarithmic decrement and periodic time of the oscillation of a circular metal cylinder submerged in the liquid helium The cylinder was 2·5 cm in diameter, and 8·5 cm in length over all, the top and bottom being bevelled in the form of cones, each 2·1 cm in height. From the top of the cylinder a stiff phosphor-bronze rod 0·07 cm in diameter extended 62·5 cm The rod and cylinder were suspended by a fine phosphor bronze ribbon 14·0 cm long The rod was sufficiently long to ensure that the suspension wire was kept at room temperature

Fuller reports of the experiment will be made elsewhere: the results only are announced here

Helium I at 4·2° K . $\eta = 0\cdot00011$ c.g.s. units
Helium I at 2·3° K . $\eta = 0\cdot00027$,, ,,
Helium II at 2·2° K : $\eta = 0\cdot000033$,, ,,

To show the definiteness of the viscosity change we may cite the following. During the course of the experiments the cylinder was set swinging in helium II ($<2\cdot2°$ K) and the pressure over the helium liquid was allowed to change to that corresponding to a temperature of 2·7° K. The cylinder continued to oscillate throughout the interval of this change of temperature, but as the state of the liquid changed from II to I, there was a very distinct and abrupt change in the logarithmic decrement, which corresponded to the above changes in the coefficient of viscosity.

This work was carried out by Messrs Wilhelm, Misener and A. R. Clarke

E. F. BURTON.

McLennan Laboratory,
University of Toronto.
Jan. 9.

An Application of Infra-Red Photography to Palæobotanical Research

TRANSFER preparations of fossil plants, particularly those of Carboniferous age, provide the palæobotanist with the plant remains separated from the rock matrix and mounted on a transparent base of Canada balsam or cellulose ester While many of these fossil remains are translucent and give the investigator the opportunity of studying some of their microscopic features by transmitted light, many are opaque with ordinary types of illumination.

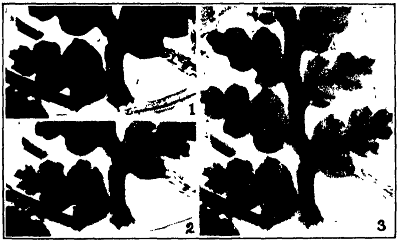

FIG 1 Photographs of transfer preparation of a fossil plant (1) by ordinary photographic plate, (2) by panchromatic plate, (3) by infra-red plate

It has been found that some of these apparently opaque fossils are translucent with respect to infra-red rays, and photographs taken on plates sensitive to the infra-red part of the spectrum reveal quite a considerable amount of detail otherwise invisible. The accompanying illustration (Fig 1) includes (1) a photograph by transmitted light of a fossil plant of Coal Measure age taken on an ordinary photographic plate, (2) is the same subject taken on a panchromatic plate with a dark red filter, and (3) is the same subject taken on an infra red plate with an infra-red filter The exposure required with the panchromatic plate was considerably longer than that required for the two other photographs The exposure with the infra-red was one minute The magnification is in each case 6·5.

It is clear that since this fossil is a thin layer of coal, this method of examining carbonaceous fossil plants may be very effective in coal petrology in the examination of coal in thin sections.

JOHN WALTON

Department of Botany,
University, Glasgow.
Jan. 15.

Scattering of Hard γ-Rays and Annihilation Radiation

To determine the relative importance of the annihilation of positive electrons in the phenomenon of the 'scattering' of hard γ-rays, observations were made on the secondary γ-radiation from thin lead foils irradiated with thorium C″ γ-rays (25 mgm) With a scattering angle of about 140°, 0·8 cm effective lead filter was sufficient to absorb practically all the Compton scattering, and still leave predominant the softer of the two components in the anomalous scattering, namely, the component which has been attributed to the annihilation of positive electrons

A sheet of paraffin wax was placed in front of the source to reduce to a minimum the number of positive electrons falling on the scatterer Measurements were made on the secondary γ radiation from foils of varying thicknesses (t) down to thicknesses of the order of, and appreciably less than, the average range (R) of the positive electrons, expected from theory, from the γ rays used. If the annihilation hypothesis is correct, the 'scattered' radiation under these conditions should, in the region $t \sim R$, decrease much more rapidly with decreasing t than its first power, owing to the escape of the positive electrons from the foil before annihilation This rapid decrease was actually found, the effect of the thinnest foil used ($\sim$ 0·002 cm) being only about 30 per cent of the value corresponding to a linear variation with t This shows that at least about 70 per cent of the scattered radiation under these conditions is due to annihilation[1]

To test further the annihilation theory of the origin of the *soft* component, it was compared, under practically identical conditions, with the Compton scattering through 79°, this angle of scattering giving Compton radiation of the same wave-length, namely h/mc, as that of the theoretical annihilation radiation Both in frequency and intensity the soft component was found to agree fairly well with the theoretical expectations, and there is no question, according to the present experiments, of the annihilation radiation being only a small fraction of the theoretical value, as maintained by Bothe and Horn[2] The theoretical intensity was estimated in the usual way from the number of positive electrons produced by the primary γ-rays according to Dirac's theory[3]

To investigate the *hard* component in the anomalous scattering, observations were made with different thicknesses of lead filter in the path of the secondary rays, up to 5 cm of lead at 140°, and up to 7 cm at 80° While a slight progressive hardening was found with increasing filter strength, throughout this range, there was no evidence for secondary radiation of primary hardness Actually, with the maximum filter thickness, the secondary radiation was definitely softer than the hard γ-rays from radium C. The latter correspond to a quantum energy of about $1{\cdot}9 \times 10^6$ volts, while the effective primary radiation in the above experiments has a quantum energy of $2{\cdot}65 \times 10^6$ volts

The initial intensity of the hard component from lead is of the order of 15 per cent of that of the half-million volt radiation It is somewhat anisotropic, being more intense at 80° than at 140° The anisotropy is more pronounced for light elements. These results are qualitatively in agreement with the supposition that the hard component is due to X-radiation from Compton electrons, and the annihilation of positive electrons before reaching the end of their range, the degree of anisotropy of such tertiary radiations being dependent on the atomic number through the nuclear scattering of the secondary electrons The importance of the first of these processes has already been emphasised by Lauritsen and Oppenheimer[4], and from more recent and detailed calculations by Wheeler and Plesset[5] it appears that the two processes will account for at least a large part of the hard component

A fuller account of the experiments described in this note, and of a more detailed analysis of the results when completed, will be published in due course The experiments were carried out at the laboratory of the Institute for Theoretical Physics, Copenhagen, and I should like to take this opportunity of thanking Prof N Bohr for his kind interest in the investigation, and also Dr J C Jacobsen and Mr K F Brostrom for their valuable assistance in the experimental work

E J WILLIAMS.

Institute for Theoretical Physics,
Copenhagen Jan 12

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[1] Cf earlier experiments by the writer using 0·1 mm lead foil and radium C γ-rays (NATURE, **133**, 415 , 1934)

[2] *Z Phys* , **88**, 683 , 1934

[3] Oppenheimer and Plesset, *Phys Rev* , **44**, 53 , 1933 Bethe and Heitler, *Proc Roy Soc* , **146**, 83 , 1934

[4] *Phys Rev* , **46**, 80 , 1934

[5] To be published in the *Physical Review* These authors have also considered other possible effects, including the Raman scattering of the primary radiation, and found them to be unimportant

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Colchicine and Tumour Growth

THE finding of considerable numbers of mitotic figures in the hæmopoietic organs of normal healthy animals and in the neoplastic tissues of tumour-bearing animals after colchicine administration has led many students to suspect an inter-relationship between mitosis and the alkaloid But the effect of colchicine in slowing down the rate of growth of neoplastic tissue has not been reported

Following on some earlier observations (unpublished, 1927) which I made in conjunction with the late Prof M R J. Hayes on the beneficial effects of deep X-ray therapy on neoplasms in patients suffering from acute attacks of gout, which were being treated with colchicum, a series of experiments was recently planned with the object of determining to what extent the colchicine might affect new growths

In one of these, a group of twelve tumour-bearing mice (*M* 63), were injected subcutaneously on alternate days with small doses of colchicine (kindly supplied by the director of the Wellcome Bureau of Scientific Research, where the work was carried out) Treatment lasted for a period of two weeks. Twelve other tumour-bearing mice were used as controls. The tumours at the end of the first week showed much less growth as compared with the controls ; while at the end of the second week there was no macroscopically recognisable tumour tissue present in 66·6 per cent of the injected animals, and only minute nodules could be detected in the remaining 33·3 per cent These nodules finally showed complete regression, and no tumour tissue could be recognised eight weeks later The controls in all but one instance showed a marked development of the tumour In another series, the percentage of animals in which there was no recognisable tumour tissue at the end of two weeks was 100 per cent

From the effects observed in these tumour-bearing mice, it was thought advisable to determine what effects, if any, could be obtained in dogs with spontaneous tumours. Of several dogs treated or undergoing treatment with colchicine, the changes observed in a spontaneous tumour in the peritonsillar region in one of these animals is sufficiently striking to warrant recording

Case history Sealyham, 11 years old. Difficulty in swallowing biscuits observed about August 26, 1934 By September 30 a marked tendency for holding his head on the left side had developed On November 19 it was difficult and painful to open the mouth The difficulty in deglutition had increased, and the animal was unable to bark On examination there was seen an ulcerated tumour on the left side of the bucal mucous membrane just ventral to the anterior pillars of the fauces on the left side, about the size of a walnut The dog was admitted to the Royal Veterinary College on December 19, 1934, and injections of colchicine were begun, following on the clinical diagnosis of epithelioma Injections were continued on alternate days and on January 9, 1935, a small portion of the tumour was excised for histological examination The clinical diagnosis was confirmed The administration of colchicine was continued and the tumour inspected daily There was a progressive diminution in the size of the growth, and on January 29 only a small scar remained at the site of the original growth

These experiments are being continued with various transplantable tumours, and a number of animals with spontaneous tumours are being treated with colchicine

The significance of these and other facts relating to the effects of colchicine in man and other animals, as well as the effects of such agents as X-rays and radium in combination with colchicine on new growths, will be published and discussed in collaboration with Dr G M Findlay, of the Wellcome Bureau of Scientific Research, to whom I am indebted for facilities and assistance in carrying out this research

E C AMOROSO.

Royal Veterinary College,
London, N W 1
Feb 4.

Identity of Vitamin B_2 and Flavine and the Nomenclature of Vitamins

ELVEHJEM and Koehn have stated[1] that vitamin B_2 and flavines are not identical Now Elvehjem and Koehn work with chicks, while Goldberger and others, who were the first to adopt the notation '*P-P* factor', which was afterwards called vitamin B_2, have used dogs and rats for their experiments The first symptom that they describe for their rats was "a tendency of the lids of one or both eyes to adhere together with, in some instances, an accumulation of dried secretion on the margins of the lid"

It is precisely this pathological condition which we have been able to cure by lactoflavine The lactoflavine that we used was prepared from milk, according to the methods devised by Kuhn Further, Miss Chick and others, who were among the first to use the notation vitamin B_2, found that a preparation of egg-white is rich in vitamin B_2. Mr. Tierie, in our laboratory, found, on exposing that extract from egg-white to sunlight, that the vitamin is lost; this suggests that this vitamin, which Miss Chick called vitamin B_2, is a flavine. Therefore I think that Kuhn is right in calling his lactoflavine vitamin B_2

These investigations demonstrate, I think, that we are adopting the wrong method in our nomenclature of vitamins by denominating them according to the letters of the alphabet When we isolate more of them—and I am sure there are still several as yet unknown vitamins—we have the trouble of giving them the right letters, and there is again the danger that two investigators may claim the same letter for quite different substances, as is the case with vitamin B_2 Also, the old system is not at all logical vitamins B_1 and B_2 are not only quite different substances, but have also very different actions, on the other hand, vitamins D_1 and D_2 probably *do not* differ very much in structure, and in action differ only quantitatively.

I should like to propose, therefore, to omit all these letters in the denomination of vitamins The vitamins that are isolated in a pure state should be given their proper names, as has already been done for some of them. So long as they remain unisolated, they may receive a provisional name, just as in the case of hormones Hence vitamin A may provisionally be called anti xerophthalmic-vitamin

Further, I propose to call the present vitamin B_1 in the future aneurin (from a[nti poly]neur[itis vitam]in). I think I have some right to propose this, as Dr Donath and I were the first to obtain this vitamin in a crystalline state

Of the other B vitamins, one is called flavin Whether this is the specific anti-pellagra vitamin or not may soon be known, when the pure flavin is tested on human pellagra patients

Vitamin C is already called ascorbic acid by Szent-Gyorgyi, which name has come into general use

One preparation of vitamin D is already called calciferol As soon as the antirachitic factor from cod liver oil, which is certainly a different substance from calciferol, is prepared in a pure state, it will receive a name

The E vitamins may provisionally be called sex-vitamins or anti sterility vitamins

It is a pity that there is no international committee to regulate this nomenclature

B. C P JANSEN

Laboratory for Physiological Chemistry,
University, Amsterdam Jan 24.

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[1] NATURE, 134, 1007, 1934.

Aluminium Chloride as a Catalyst of Hydrogen Interchange

THE Friedel Crafts reaction

$$RCl + C_6H_6 \xrightarrow{AlCl_3} C_6H_5R + HCl$$

suggests the use of $AlCl_3$ as a catalyst for the interchange of hydrogen between benzene and hydrogen chloride We have found this expectation confirmed in the following experiments · 0 5 gm of $AlCl_3$ was brought into contact, for three hours, in a vessel of about 100 c c capacity, with a mixture of ordinary benzene and hydrogen chloride containing 13 4 per cent D, the temperature in two runs being 25° and 50° respectively

Temp	Benzene	Pressure of hydrogen chloride	Per cent D in hydrogen chloride after treatment
25°	0 107 g	178 mm.	1 23
50°	0 095 g	297 mm	1 08

From the analysis of the hydrogen chloride given in column 4, it follows that in both cases more than 90 per cent of the D had passed over from the hydrogen chloride into the benzene. This has been confirmed by analysing the benzene formed We have found indications that under the above experimental conditions the reaction proceeds to some extent, even when no $AlCl_3$ is present, but in this case it goes at a much slower rate

J. KENNER
M POLANYI.
P SZEGO

University of Manchester.

Crystal Structure of Cyanuric Triazide

IN connexion with the discussion on dipole moments held by the Faraday Society at Oxford in April 1934, Sir William Bragg described[1] briefly the results of a research, which I had been making on the structure of cyanuric triazide A Fourier analysis of the measured X-ray intensities of (*hk*0) planes showed the three nitrogen atoms of the azide group to be in a straight line[2] Details of the research were promised later and were held up for an absolute intensity determination to be made. The calculations are now completed and will, I hope, be published soon

Mr E W Hughes has now published[3] a structure which resembles mine, but differs from it in certain important features He shows the azide group as departing from linearity by 15°, while I find that any departure from the straight line could not exceed 3° or 4° The distances between the centres of the atoms in the cyanuric ring he finds to be all equal, thus indicating an oscillating double bond as in benzene I find these distances alternately larger and smaller, corresponding with fixed single and double bonds respectively. The inter-atomic distances which I find are not in complete agreement with his. Mr Hughes's estimates of the intensity of X-ray reflections were made by eye and I cannot think this a sufficiently safe or accurate method for the purpose My measurements were made by means of a Robinson photometer and put on an absolute scale by the accurate method of the ionisation chamber

I. ELLIE KNAGGS

Davy Faraday Laboratory,
Royal Institution, W 1

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[1] NATURE, 134, 138, 1934
[2] *Trans Far Soc*, 30, 826, 1934.
[3] *J Chem Phys*, 1, 1935

Spectra and Latent Energy in Flame Gases

IN a recent letter on the above subject, Prof. W. T David[1] points out that after flame has travelled through an inflammable gaseous mixture, the gases remaining emit luminous (visible and ultra-violet) radiation for a considerable period of time if their temperature is kept up. In an investigation carried out at the United States Bureau of Standards, accounts of which have already appeared[2,3,4], evidence of prolonged emission in the infra-red was obtained from observations of flame in the cylinder of an engine delivering power.

Infra-red radiation (to about 11μ) was recorded from explosions in a small single cylinder L-head engine, through fluorite windows let into the engine head. The fuels used were benzole, and benzole blended with a low-grade petrol. Observations were made of a small depth of charge perpendicular to the direction of flame travel, so that radiation was successively recorded from unburned charge ahead of the flame front, from the flame front, and from gases remaining behind the flame front Curves of radiation against crank angle were initially horizontal, rose sharply (at the instant visible flame appeared under the window in use) to a maximum, and then decreased gradually

From gases under a window adjacent to the sparking plug, radiation from non-knocking explosions reached a maximum slightly before maximum pressure was recorded in the cylinder, and at the same instant visible flame appeared under another window, slightly more than 10 cm. away in the direction of flame travel (This distance corresponded to 20°–25° of engine crank rotation)

From gases in the 'knocking zone', radiation from non-knocking explosions continued to rise for 20° of crank angle after the arrival of visible flame in knocking explosions visible flame arrived earlier, and a higher maximum radiation was reached, 15° later as against 20°. For both non-knocking and knocking explosions, maximum pressure in the cylinder preceded maximum radiation

Later in the cycle, both radiation and pressure curves for knocking explosions were below those for non-knocking, indicating greater loss of energy from the charge involved in the knock.

The fact that radiation through a given window continued to rise for approximately 20° of crank angle after the arrival of flame under that window was taken as evidence that formation of H_2O and CO_2 molecules continued for at least this period, and probably longer, after inflammation Some doubt was consequently expressed concerning the assumption, based on oxygen determinations at successive moments during the cycle, that combustion is completed in a narrow flame front[5]

It may be that, in an engine cylinder, some metastable H_2O and CO_2 molecules are formed, which then part with their latent energy, either communicating it to neighbouring molecules or emitting radiation on the wave-lengths characteristic of H_2O and CO_2 This would make it easier to reconcile the 20° lag between the appearance of flame and the attainment of maximum radiation in the infra red, with the shorter period required for combustion to be completed in a narrow flame front. It is also possible that the phenomenon of fuel-knock may be connected with the proportion of metastable molecules formed during combustion

SYDNEY STEELE.

7, Sefton Avenue,
Widnes, Lancs
Dec. 9.

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[1] NATURE, 134, 663, 1934
[2] Steele, NATURE, 128, 185–6, 1931
[3] Steele, *Ind Eng Chem*, 25, 388–93, 1933
[4] Marvin, Caldwell and Steele, National Advisory Committee for Aeronautics, Technical Report No 486, 1934
[5] Withrow, Lovell and Boyd, *Ind Eng Chem*, 22, 945, 1930.

Diamagnetism of Light and Heavy Water

THE molecular diamagnetism of light water, 12·97, has been closely approached in the values hitherto published for heavy water: 12 90[1] and 12·76[2]. A coincidence has been observed in this department by J. H. Cruickshank, using a Curie-Chéneveau magnetic balance: the molecular diamagnetism of heavy water was 12 96 ± 0·02. Additional measurements on light/heavy water mixtures, containing 44, 62 and 87 per cent of heavy water, showed strictly additive susceptibility H_2O, D_2O and HDO therefore appear to have identical molecular diamagnetisms, and to have no influence on one another's magnetism

J H Cruickshank, however, has carried out a more refined measurement, and noticed a peculiar lag in which appears an observable magnetic difference between the two waters The change in susceptibility of freshly melted water, the temperature of which had been allowed to rise to that of the balance, 18° C, was followed over a period of 30 minutes after melting by continuously reading the deflexions The readings gradually increased to a maximum at 20 minutes after melting, and then fell slightly to a constant value

According to recent views[3,4], the state of co-ordination of water is such that the molecules are, for geometric reasons, held farther apart than they would be in a state of closest packing Therefore, although the local effect of co-ordination is to lower the diamagnetism at the bonds, the volume effect prevents depression at other points and keeps the diamagnetism up In ice, co-ordination is a maximum, in freshly melted water, there is a lag in deco-ordination shown by a continuous change in the susceptibility This change is an increase to begin with, because the deco-ordination local effect (with its rise of diamagnetism) is predominant Later, the corresponding volume effect (with its fall of diamagnetism) becomes more effective, as seen in the development of a maximum value

In heavy water, both the increase in susceptibility to the maximum value and the subsequent fall to constant value are less than in light water, but take place *in the same time* *Deco-ordination in heavy water tends to take place less readily than in light*, but the higher degree of co-ordination in the equilibrium state, and the accelerating effect on deco-ordination of the higher initial temperature, 3 8° C, counteract this tendency, with the result that equilibrium is reached in the same time as for light water The rise to and the fall from the maximum susceptibility are less because the total loss of co-ordination required to reach equilibrium is less and thus there is less scope for display of lag

It has been assumed that the temperature of the water rose to 18° C before the observations were begun, but the rise in susceptibility due to a still rising temperature requires to be added to the rise in susceptibility due to the local effect of deco-ordination This makes the rise to the maximum greater than the fall to the equilibrium

During an ordinary determination of susceptibility, the lag described here escapes observation because it is finished long before the constant can be determined

The same experiment was tried with benzene m p. 5 4° and aniline m p −8°, but in neither case was a maximum observed, although it could be seen repeatedly with the waters

FRANCIS W. GRAY.
JAMES H CRUICKSHANK

Department of Chemistry,
University, Aberdeen
Dec 17

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[1] Selwood and Frost, *J Amer Chem Soc*, **55**, 4335, 1933
[2] Cabrera and Fahlenbrach, *Naturwissenschaften*, **22**, 417, 1934
[3] Bernal and Fowler, *J Chem Phys*, **1**, 515–548, 1933
[4] R H Fowler, *Proc Cam Phil Soc*, **30**, 225–241, 1934

Spectrum of Doubly Ionised Iodine

WORK on the identification of the lines belonging to this spectrum was begun more than four years ago and a preliminary announcement on a clue obtained which was expected to lead to an analysis of the spectrum was made at the time in these columns[1] That clue, however, did not lead to the expected result, and had to be abandoned Finally, it was realised that the only way of solution, though necessarily a very lengthy and tedious one, was to find all possible differences between the wave-numbers ascribed to this spectrum

For this purpose the measurements made by Kerris[2] were used and, confining the frequency differences up to within about 15,500, nearly 35,000 subtractions were effected From these has been sorted out what is believed to be a genuine regularity among 50 lines of the spectrum The agreement among the various differences occurring in this intercombination is of the order of 0 2 This has led to the identification of most of the terms in the 6*s* and 6*p* levels and a few in the 5*d* level The relative values of the terms are –

6*p* level	0, 68 5, 1731 0, 2790 7, 4851 0, 5071 4, 6587 1, 8193·7, 10965 2, 12988 9.
6*s* level	28222 3, 29630 3, 29908 9, 30272 0, 30503 0, 32839 7, 35299 4
5*d* level	24618 6, 27004 7, 40686 6

Details of the work up to date are being sent for publication in the *Indian Journal of Physics*

J B SETH

Physics Laboratory,
Government College, Lahore
Dec 24

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[1] NATURE, **127**, 165, 1931
[2] *Z Phys*, **60**, 20, 1930

'Viscacelle' as a Material for making Compensating Plates and Wedges for the Polarising Microscope

'VISCACELLE' (cellulose sheet manufactured by Messrs Courtaulds by the viscose process and used extensively as a wrapping material) is birefringent There seems little doubt that this property is due to a net orientation of the long cellulose molecules caused by the unidirectional tension to which the sheet is subjected while being 'spun' Under this tension, the molecules may be expected to arrange themselves so that their length directions are parallel or nearly parallel to the direction of tension This explanation is supported by the fact that the direction of tension (revealed on cut sheets by parallel streaks) is the 'slow' direction of vibration

The accompanying table gives some relevant properties of specimens of different grades of 'Viscacelle' supplied by Messrs Courtaulds The relative retardations were deduced from the polarisation colours by means of Lévy's colour chart of birefringences

Manufacturer's Classification	Thickness (mm)	Polarisation Colour and Relative Retardation (mμ)
300 Ordinary, Grade 1	0 020 – 0 025	(3 layers) purplish red, c 575
300 Ordinary, Grade 2	0 020 – 0 025	(3 layers) orange red, 450–480
400 Ordinary, Grade 1	0 025 – 0 030	(3 layers) bright blue, c 650
600 Ordinary, Grade 1	0 040 – 0 045	(1 layer) pale yellow, 300–340 (2 layers) bright blue, c 650
300 Moistureproof, Grade 1	0 020 – 0 025	(3 layers) bright blue, c 650

The figures show that the thinnest specimens ("300" grades, 0 020–0 025 mm) have, in single layers, relative retardations approaching, though in the main somewhat greater than that of the quarter-wave mica plate, and a strip of the material bound between two glass slips by means of pieces of gummed label can in fact be used as a satisfactory substitute for this accessory Three layers of the "300 Ordinary" mounted in the same way can be used in place of the unit retardation selenite plate, whilst a step-wise pile of strips affords an alternative to the mica stepped wedge or quartz wedge The colours given by such a wedge appear to be quite normal

It must be emphasised that the figures in the table refer to particular specimens However, I have examined a number of other specimens taken from proprietary articles without finding wide deviations, and it seems that the birefringence of the material may be taken as roughly constant for a given thickness It may happen that several specimens of the "300" thickness have to be tried before one is found from which a sensitive red can be built up It may be mentioned that the higher birefringence of the moistureproof sample (last in table) as compared with others of the same thickness is not connected with its protective coating, for when this was dissolved off with a mixture of acetone and ethyl acetate, no apparent decrease in the birefringence was observed.

I am indebted to Messrs Courtaulds for supplying graded samples and for information concerning the manufacture and properties of the material

N H **Hartshorne**

University College
Swansea
Jan 10

Dimensions of Electric and Magnetic Units

If in a recent letter[1] Sir James Henderson uses the word 'dimensions' in its customary sense of relation to the units of length, mass and time, he is arousing false hopes by suggesting the possibility of a 'discovery' of the dimensions of μ_0 and K_0, for these dimensions, and not merely the numerical values of the quantities, are both completely arbitrary, depending upon the units of measurement which may be selected

It has indeed been proved that $A^2/\mu_0 K_0 = c^2$ where A is the quantity appearing in Ampère's equation and c is the velocity of propagation of electromagnetic waves in a vacuum, but it still remains true that μ_0 and K_0 may each be separately given any values whatever In some systems of units which have been adopted or discussed, for example, in the Gaussian system, separate values have been assigned to each, in other systems, as in the 'electrostatic' and in the 'electromagnetic' system, a value has been assigned to either K_0 or μ_0 and the other obtained from it by an arbitrary assumption such as $A = 1$, while other recently discussed systems are founded upon the adoption of two independent arbitrary assumptions from which the values of K_0 and μ_0 can be deduced, but for purposes of measurement, as distinguished from historical or more or less sentimental considerations, a system depends only upon the values of K_0 and μ_0 characteristic of it and not at all upon the methods by which these values were finally reached

It is true that the electronic theory asserts that a magnet is not merely equivalent to but identical with a certain system of electrons in motion, but the argument that this identity necessarily requires the adoption of a system of units in which $\mu_0 = 1$ or in which mL must be dimensionally equal to iL^2 is altogether unsound

Sir James may readily convince himself of this by the examination of the following simple example The modern form of the electronic theory obviously suggests the existence of a 'natural' system of electromagnetic measurement in which the unit of electric quantity will be the electron and the unit of magnetic moment will be the Bohr magneton The 'natural' unit of current will be such that a current i will involve the net passage of i electrons per unit of time and the 'natural' unit of quantity of magnetism will be such that two equal and opposite quantities m of magnetism separated by one unit of length will have a magnetic moment of m magnetons On this system it is obvious that mL is dimensionally a numeric while the dimensions of iL^2 are L^2/T, and it is easily deducible that the dimensions of K_0 are T^2/ML^3 and of μ_0, T^2/ML^5 The numerical values of these quantities will, of course, depend upon the units of length, mass and time adopted

It is scarcely necessary to remark that the theoretical charms of such a 'natural' system are totally eclipsed by its practical inconveniences

L R **Wilberforce**

University of Liverpool
Jan. 21.

[1] NATURE, **135**, 105, 1935

Structure of the Caudal Fin of the Cod

With reference to Dr Whitehouse's suggestion[1] that the caudal fin of the cod is of a normal homocercal type, may I state that I have just completed a study of the development of this fin, as a result of which I can affirm that, while it certainly preserves indications of its homocercal origin, it would be misleading to apply the term 'homocercal' to it in its present form

Whereas in the homocercal fin practically the whole of the web is supported by morphologically ventral skeletal elements belonging to the hypochordal lobe, in the Gadoid fin the upper half of the web is supported by morphologically dorsal elements which arise in a dorsal fin fold, this growing back to fuse with a corresponding ventral fin fold and thus form the symmetrical web Now Agassiz[2] long ago showed that, because the homocercal fin developed as an exaggeration of heterocercy, the terminal 'axial lobe' of the embryonic caudal fin (in which is included the tip of the notochord) forms a small dorsal lobe to the developing definitive fin He was, however, unable to find this lobe in the cod, as can be well understood from my own observations, which show that it is suppressed between the developing dorsal and ventral components of the fin, it is here, in other words, medial rather than dorsal in position.

For this and other reasons the term 'pseudocaudal' appears to me to be the most satisfactory designation for the Gadoid fin A full report and discussion of my results will be published elsewhere

E J. W **Barrington.**

Department of Zoology,
University College,
Nottingham
Jan 14.

[1] NATURE, 135, 70, January 12, 1935

[2] *Proc Amer Acad*, **12**, 1877

Evolution and Human Origins

MY attention has been directed to the leading article in the issue of NATURE of January 26 in which criticisms are made on an address by me to the Victoria Institute recently. I have no desire to enter *into further written controversy on the subject* just at present, and you might probably be unable in any case to afford space for it in the pages of NATURE. If, however, no notice were taken of the objections urged, it might be considered that silence gave consent or that no answer is possible. I beg therefore by your courtesy to say that when, as seems probable, a new edition of the address is published, careful consideration will be given to the arguments in your leading article and such counter-arguments or replies presented as are necessary or possible. This will probably be a more convenient way of dealing with them than extending the controversy at the present time in the pages of your valued periodical.

Sidmouth, South Devon AMBROSE FLEMING
Feb. 3.

More Work for the R.S.P.C.A.

MUCH satisfaction must have been felt by lovers of the lower animals in reading the review in NATURE of February 2 (p. 164) of the work accomplished by the R.S.P.C.A. since its foundation in 1824. It encourages one to hope that the Society will delay no longer in pressing for prohibition of the cruel practice of docking the tails of horses.

It is not likely that any serious opposition would be offered to such legislation as may be necessary to render docking a penal offence. Something might be accomplished if horses mutilated and disfigured in this senseless manner were disqualified as prize-winners in the show ring; but that would not act as universal prohibition. One has but to watch horses thus mutilated when turned out to grass in summer to realise what they suffer from swarms of flies.

Fortunately, the practice of docking is not nearly so general as it used to be. During the Peninsular War, the Duke of Wellington required all cavalry chargers to be so treated in order that they might be distinguished from those in the French army. At the present time, however, the horses of British cavalry and those in all racing and most hunting establishments are not docked; but many farm horses and trotting cobs are still subject to the removal of some of their lower vertebræ.

HERBERT MAXWELL.

Monreith.

Points from Foregoing Letters

THE behaviour of liquid helium indicates that it exists in two forms, helium I and helium II. Their viscosities have been determined in Prof. E. F. Burton's laboratory at Toronto. It appears that when helium I, which is formed at 4·2° K., is further cooled, it becomes more viscous down to 2·3° K.; at 2·2° K. the liquid suddenly becomes more fluid as it changes into helium II.

Thin layers of carbonaceous fossil plants such as are present in coal, while opaque to ordinary light, allow the passage of infra-red radiation. Prof. John Walton submits photographs of a fossil plant taken in red and infra-red light, the latter showing marked internal structure.

It has been suggested that γ radiation may be changed into positive electrons and vice versa. Dr. E. J. Williams finds that very thin lead foils (about 0·002 cm. thick), when irradiated with γ rays from thorium C″, yield less than the calculated amount of secondary γ-rays. This he interprets as evidence that the positive electrons produced by the original γ-rays escape from the lead-foils before they are 'annihilated' and changed into the softer secondary γ-rays. The more penetrating γ-rays scattered by lead-foil are ascribed to γ-radiation from recoil electrons and to the annihilation of positive electrons before reaching the end of their journey.

Colchicine, the active substance from the seeds and corm of the meadow saffron, hitherto used in the treatment of gout, has been found by Dr. E. C. Amoroso to be effective in treating a spontaneous tumour in a dog. Dr. Amoroso also states that colchicine has effected the regression of tumours transplanted on mice.

Prof. B. C. P. Jansen supports Kuhn's claim that lactoflavine is identical with the originally described vitamin B_2, since both have identical effects on dogs and rats and are rendered inactive by exposure to sunlight. Prof. Jansen advocates the use of descriptive names instead of letters to indicate the various vitamins.

Prof. W. T. David has put forward the view that 'metastable molecules' account for the after-glow of gases following upon an explosive reaction. Dr. S. Steele recalls previous observations showing prolonged emission of *infra-red radiation during* the explosive reactions which take place in a combustion engine. He suggests that in an engine cylinder some metastable H_2O and CO_2 molecules may be formed.

The magnetic susceptibility of freshly melted water increases during the first twenty minutes and then falls to a constant level. This is explained by Dr. F. W. Gray and Mr. J. H. Cruickshank as due to the lag in the rearrangement of the water molecules (each molecule of H_2O is surrounded by four others in a more or less tetrahedron fashion; this arrangement is somewhat different in ice and in water). With heavy water a similar but less pronounced change with time is observed.

Dr. N. H. Hartshorne directs attention to the fact that transparent cellulose sheets behave towards light in a manner similar to that of crystals of mica, selenite and quartz, and in appropriate thicknesses may be substituted for them in making compensating plates and wedges for the polarising microscope.

Commenting on a letter from Sir James Henderson, Prof. Wilberforce shows that the accepted theory of the identity between magnetic phenomena and electronic motion does not establish, as a necessary deduction, the equations $\mu_0 = 1$, $K_0 = 1/c^2$, but on the contrary suggests a different 'natural' system of electromagnetic measurement attractive in theory but inconvenient in practice. The theory of dimensions has often been useful in deducing new physical laws.

Research Items

The Bones of Comenius. Very shortly after the death of the great Czech scholar, John Amos Comenius, in Holland in 1670, his fame, and even his last resting place were forgotten owing to disturbed conditions both in his native land and in Holland. In the earlier part of the nineteenth century his memory was revived; but notwithstanding an abortive attempt to fix the site of his grave in 1871, it was only after the close of the War that the Czechoslovakian Government was able to make arrangements with the Dutch authorities for the disinterment of his remains. This was made possible by the discovery of the register recording his interment in November 1670, not in the 'great church' of Naarden, as had previously been thought, but in the 'Walloon' church. This edifice, after a varied history, had long been occupied as a military barracks. The records showed that the body of Comenius had been deposited in a 'common' grave, in which two further interments had followed after considerable intervals. Largely owing to the interest of Mr R. J. Vonka, of the Czechoslovakian Legation, and Dr R. A. B. Oosterhuis, of Amsterdam, this grave was identified and one of the three skeletons provisionally identified by its position and general condition as that of the great scholar. The remains have been examined and measured in detail by Prof A. J. P. van den Broek and Prof J. Matiegka, who after a close comparison with portraits of Comenius and such information as is available, pronounce the identification to be in all probability well founded. The skull is hyperbrachycephalic (cephalic index of 89·71), hypsicephalic (vertical index 77·64), eurymetopic and mesoprosopic. The orbits are large and the nose thin. The form and dimensions of the skull, in fact, are such as are frequently encountered in Czechoslovakia. Among the more noteworthy features are the breadth of forehead and the fact that, notwithstanding the age of the subject at the time of death, the sutures of the skull had not closed. The discovery of the remains and their character and method of identification are described in *Anthropologica* (Académie Tchèque des Sciences et des Arts, Prague, IIme Classe, 1933, just received).

Prehistoric Rock Paintings in Abyssinia. The Abbé Breuil describes in *L'Anthropologie* (**44**, No. 5-6) a number of rock-paintings in the Harrar (Abyssinia) which he examined in 1933, when Dr Paul Wernert was engaged in the excavation of the palæolithic cave of Porc Epic at Diré Daoua. One series of paintings was in the cave and a second was on a rock discovered by P. Azaïs at Sourré, sixty kilometres from Diré Daoua. The cave of Porc-Epic is situated at the top of a cliff about 200 metres above the right bank of the River Diré-Daoua. Its deposits, separated by two thin layers of stalagmite, belong to mesolithic and upper palæolithic cultures analogous to those of Kenya and South Africa. In the upper and middle deposits, moustero solutro aurignacian implements are associated with geometrical microliths and a coarse pottery. On the right wall are a number of drawings, all more or less schematic, which are partly covered by deposits and, consequently, are older than the more recent stalagmite. The figures are highly conventionalised and, therefore, difficult of identification. Approximately, however, a list can be established which includes twenty human figures comparable to the most schematic of southern Spain, one elephant, one lion, two carnivores with pointed muzzle and ears, thirteen antelopes, three Bovidæ, etc. Nearly all are in bright red, but there are the remains of earlier figures in yellow ochre and a reddy-brown. The only remarkable figure is that of a stag, which is compared with a similar figure from Zara Brouk (Adiliet). The paintings on the rock at Sourré are of varied dating, distinguishable by the superpositions. They fall into eight classes which belong to two main periods, the five earlier stages being naturalistic, while of the later three, two are schematic phases united by a period of transition. There is a hunting scene, but all the remaining figures are of a pastoral character. They recall pre- and proto-dynastic Egypt. The identification of certain of the Bovidæ raises an interesting point bearing on the domestication of these animals.

Mitogenetic Radiation. The announcement, twelve years ago, by Gurwitsch, of the emission of radiations from rapidly growing tissues, occasioned no little interest and even surprise in biological circles, coming as it did from a histologist with so high a reputation. Many have been the attempts to repeat his observations, but the results of succeeding investigators have yielded positive and negative results as consistently as the tossing of a coin. Dr J. B. Bateman has rendered valuable service to biological workers in carrying out a critical survey of the literature of the last dozen years dealing with this subject ("Mitogenetic Radiation", *Biol. Rev.*, **10**, 1, 42; 1935). The weight of the evidence tends slightly against the existence of such a phenomenon, and there is no ground at all to support the view that mitogenetic radiations, if they exist at all, have anything to do with ultra-violet radiation.

Statistics of Variations. Dr Hans Günther has recently published a little book which serves as a short but useful introduction to the statistics of variation ("Die Variabilität der Organismen und ihre Normgrenzen". Pp. 132. Leipzig: Thieme, 1935). It is divided into fourteen sections, some of which may be mentioned as indicating its scope and character: the causes and categories of variation, statistical and biometrical methods, the conception of the norm and of the abnormal, the limits of variation and of the norm, various types of biological statistical analysis, and special methods for the comparison of variations, as between, for example, races, populations, the sexes, the right and left halves of the body and different stages of development. Various general questions regarding the nature and limits of variations are discussed.

Lamellibranchs and a Cruciform Muscle. Mr Alastair Graham, following up his recent investigations of the cruciform muscle of certain Lamellibranchs (NATURE, Sept. 29, 1934, p. 500), has compared in detail the anatomy of five bivalves belonging to the Tellinacea, *Gari tellinella*, *Tellina crassa*, *Macoma balthica*, *Scrobicularia plana* and *Donax vittatus* together with *Cultellus pellucidus* as typical of the Solenidæ, and *Solecurtus scopula* and *S. chamosolen* as representing the *Solecurtidæ* (*Proc. Roy. Soc. Edin.*, **54** (2), No.

15, 1934). The result of this work, as was foreshadowed in the previous paper, shows that the Solecurtidæ should be classified with the Tellinacea rather than with the Solenidæ. The Solecurtidæ, in common with the Tellinacea, possess a cruciform muscle and in many other respects resemble that group, whereas in the Solenidæ the cruciform muscle is absent. The Solecurtidæ have, however, several features which are characteristic of the Solenidæ and there appears to be an undoubted relationship. As the author suggests, "the Solecurtidæ are to be regarded as a group of Lamellibranchs linking the Tellinacea with the Solenacea, but themselves retaining many more primitive features than do the Solenacea, and therefore falling themselves into the former group". The Solenidæ probably separated from the ancestral forms of the Solecurtidæ and the other Tellinacea before the evolution of a cruciform muscle had taken place, and since their separation have evolved along a well defined line of their own. It is an interesting fact and one not easily explained that in the two estuarine species of the Tellinacea, *Macoma balthica* and *Scrobicularia plana*, the length of the intestine has become greatly elongated by coiling.

New Fresh-Water Mollusca. Mr Alan Mozley has described several new fresh water molluscs from northern Asia (*Smithsonian Miscellaneous Collections*, **92**, No. 2, 1934). These were collected during a journey made in the years 1932 and 1933 through certain parts of Siberia and northern Kazakstan, the object of the expedition being to investigate the molluscan fauna of the region. The new species are all very like known British forms, a *Valvata*, a *Lymnaea*, a *Planorbis* and a *Physa*, and there are three new sub species of *Lymnaea (Galba) palustris* described. The descriptions are of the shells alone, in some cases at least, only dead shells being obtained. *Valvata antiquilina*, n. sp., from Lake Khomotenoze, apparently lived at some former time when the water level stood considerably higher than at present. *Limnaea palustris sandalensis*, n. subsp., comes from a small somewhat saline lake on the Steppe Sari Dala, south west of Pavlodar, northern Kazakstan. Although distinguishable, these four sub-species resemble one another closely.

Tortrix Moth Pests of Fruit Trees. Messrs G. L. Hey, of the Murphy Chemical Company, and F. J. D. Thomas, of the East Malling Research Station, have recently published an account of their investigations into the biology of *Cacœcia (Tortrix) podana*, Scop. (*J. Pomol. and Hort. Sci.*, **12**, No. 4, pp. 293–310, December, 1934). The paper is the first of a series which is intended to include descriptions of a considerable number of Tortricidæ which infest fruit trees in Britain. *C. podana* was first described in 1854, and is now distributed throughout Europe, though it has not yet reached the United States. Characters of the larva in all its seven instars are described in the paper under review, and its depredations in each stage are considered. The pupa and mature insect receive shorter treatment. An extensive list of host plants, and a graphic description of damage done, give an idea of the economic significance of the pest. Methods of control depend upon the host plant. Larvæ can be removed from rhododendrons by spraying with lead arsenate, while this wash has little effect on the pest as it occurs on fruit trees, where the method of feeding is different. Traps placed around a bright light at night exterminate considerable numbers of mature moths, and several parasites of the larva are known.

A Wilt of Snapdragons. A serious disease of snapdragons recently occurred near Pretoria, South Africa. It was very swift in its action, for affected plants were often apparently healthy one day, and permanently wilted the next. The young roots and the base of the stem rotted and were frequently discoloured. The cause of this troublesome malady was investigated by Dr Margaretha G. Mes ("A Wilt of Snapdragon, *Antirrhinum majus*, in South Africa", *S. A. J. Sci.*, **31**, pp. 281–287, Nov. 1934). Two fungi were isolated from diseased tissues, one belonging to the genus *Phytophthora*, and the other to *Fusarium*, but infection experiments demonstrated that the former was the real pathogen. *Fusarium* was, however, responsible for discoloration of wilted plants. The disease producing organism was identified as *Phytophthora pini*, var. *antirrhini*, but appears to have been classified also as a form of *P. cactorum*. Zoospores have been demonstrated, and the antheridia and oogonia are typical of the genus.

Vernalisation. Since the publication of Bulletin No. 9 on vernalisation by the Herbage Bureau, Aberystwyth, research on the subject has been proceeding rapidly in the U.S.S.R. The many conflicting statements that have appeared in the scientific and popular literature, however, have made it desirable that an authoritative account of the subject should be given, and the Bureau, with the collaboration of Prof. N. A. Maximov, of the Institute of Grain Husbandry, Saratov, U.S.S.R., has issued a further publication, "The Theoretical Significance of Vernalization" as Bulletin No. 16 in the Herbage Publication Series (Aberystwyth: Imp. Bur. Plant Genetics, *2s. 6d.*). Since the discovery that by subjecting partially soaked seed to low temperatures, winter varieties of cereals could acquire the properties of spring varieties, that is, yield the same summer, the investigations have been extended to other types of plants. In the case of soy bean and cotton, vernalisation is effected by exposure of soaked seed to sufficiently high temperatures, after which fruit is formed successfully, even if subsequent temperatures would normally be too low. On the theoretical side, Lysenko's views are discussed in full, the most important of which seems to be that growth and development are essentially different phenomena. The plant, although in an apparently dormant condition, may be undergoing transitional developmental processes which can be profoundly affected by external conditions. Changes in the nature of the plant's composition are also brought about by vernalisation, both the colloidal properties of the protoplasm and the staining reaction of the embryonic tissue being altered after treatment. The first idea, that vernalisation actually accelerated plant development, is now regarded as needing modification. The truer interpretation seems to be that part of the growth period, which normally takes place in the field, can be transferred back to the early germination stages. The question as to whether or not vernalisation is an irreversible process is still a debatable point.

Recent Changes of Level in Japan. In the latest number of its *Bulletin* (**12**, 851–860, 1934), the Earthquake Research Institute has issued a valuable series of plates that illustrate recent changes of level in Japan During the last two years, a new line of precise levels has been carried out along the route bordering the east coast from near Tokyo northwards to Kamaisi and thence across the Main Island to Akita Throughout the whole course of more than 350 miles, the crust since the last surveys (usually made between 1894 and 1900) has, with a few small exceptions, subsided The principal movements are described by Messrs T Terada and N Miyabe (*Tokyo Imp Acad Proc*, **10**, 557-560, 1934). They consist of V-shaped depressions, one of which, about 100 miles north north east of Tokyo, has reached a depth of 32 in in about thirty six years It lies in a line with the valley of the River Natui, a zone of frequent earthquakes Another, of about 6 in in thirty-four years, occurs on the cross country route about 36 miles south east of Akita. Some miles nearer the latter town, the curve of depression shows a marked break where it crosses the fault associated with the severe earthquake of March 15, 1914

The Oxygen Afterglow E M Stoddart (*Proc Roy Soc*, A, Dec. 1, 1934) has investigated the afterglow obtained in oxygen, both in electrodeless high-frequency discharges and in discharges between aluminium electrodes Pure oxygen showed no afterglow with electrodeless excitation, whether or not the surfaces of the tube were 'poisoned' with water vapour This poisoning had been found by former workers to be necessary for the afterglow No afterglow was produced by the addition of various other gases including nitrogen With the electrode discharge, no afterglow was found with pure oxygen, but the addition of a little nitrogen produced a powerful afterglow By connecting the tube with a trap cooled in a carbon dioxide freezing mixture, nitric oxide was shown to play a part in the afterglow The afterglow gradually disappeared and nitrogen peroxide could be recovered from the cooled trap. No nitrogen peroxide was found in the electrodeless discharges A spectral examination of the afterglow showed weak diffuse bands which are not oxygen bands The author concludes that nitric oxide is formed by a process involving the metal electrodes in the tube, and that the emitter is the same as is present in the chemiluminescence of nitric oxide and ozone

The Limits of the Continuous β-Ray Spectrum H O W Richardson has recently discussed the low energy β rays of radium E and W. J Henderson has investigated the high energy limit of the β rays from thorium C and C″ (*Proc Roy Soc*, A, Dec 1). The deposit of radium E was made on a thin aluminium foil and was placed in a Wilson expansion chamber The energies of the electrons were deduced from their range, and in evaluating the distribution, corrections were made to allow for the loss of the ends of tracks by passing out of the illuminated field and in other ways. A number of the tracks observed are of secondary origin, but there is some evidence of a low energy group of β-rays from radium E The paper by W J Henderson describes an analysis of fast γ rays from thorium C and C″, using the semicircular magnetic focusing method with a pair of Geiger-Muller counters as a detector The counters are mounted so that a β-ray passes through both counters, which are separated by a thin mica sheet Only coincident discharges of the counters are recorded, and this method reduces by a factor of 25 the effect of the γ-rays from the source, which would otherwise mask the β-rays completely in spite of the lead screening The distribution curves for the sources of thorium B + C + C″ slope steeply down to an end point at 2·25 × 10^6 volts, while those for the sources of thorium C″ prepared pure by recoil have an end point at 1 795 × 10^6 volts Beyond these limits there is a slight background and a line at Hρ 10,280 known to arise from thorium C″ The experiments show that in the two alternative modes of decay of thorium C,

$$\begin{tikzcd}
 & \text{Th C}' \arrow[dr, "\alpha"] & \\
\text{Th C} \arrow[ur, "\beta"] \arrow[dr, "\alpha"'] & & \text{Th D,} \\
 & \text{Th C}'' \arrow[ur, "\beta"'] &
\end{tikzcd}$$

the maximum energies by the two paths balance exactly. This is in accordance with the theoretical suggestions of Ellis and Mott, according to which the maximum energy of the β-rays represents the difference in binding energies between the parent and product nuclei The energy missing when a β-particle of lower energy is emitted has not yet been traced

Magnetic Properties of Bivalent Samarium. Although bivalent samarium compounds have been reported as non-existent, P W Selwood (*J Amer Chem Soc*, **56**, 2392, 1934) has prepared the dibromide by heating the tribromide in hydrogen and has measured its magnetic susceptibility. This is found, at various temperatures between about 100° and 400° abs, to be almost the same as that of tervalent europium This is the result which would be anticipated from the Sommerfeld-Kossel rule, which states that ions with equal numbers of electrons often have very similar properties The arrangement of electrons in tervalent europium is (from the $4f$ shell outwards) $4f^6 5s^2 5p^6$ In bivalent samarium it is probably the $6s$ and one of the $5d$ electrons which are lost, $4f^5 5s^2 5p^6 5d(^2 6s)$ The remaining $5d$ electron, however, migrates to the $4f$ shell, thus producing a configuration identical with that of tervalent europium The result is of added interest because both samarium and europium have anomalous temperature coefficients of magnetic susceptibility. A previously reported discrepancy in the susceptibilities of the compounds Sm_2O_3 and $SmBr_3$, of tervalent samarium, was not found.

Atomic Weight of Protactinium. A specimen of protactinium oxide which showed no impurities by the X-ray method has been prepared and utilised in the determination of the atomic weight of protactinium (A. V Grosse, *J Amer Chem Soc*, **56**, 2501, 1934). Potassium protactinium fluoride, K_2PaF_7, crystallises in beautiful colourless needles, can be dried to constant weight, and can be reconverted into the oxide by treating with sulphuric acid, diluting, precipitating with ammonia and igniting In two determinations, 0·091907 gm and 0 070047 gm of K_2PaF_7 gave, respectively, 0·056274 gm and 0·042913 gm of Pa_2O_5 The atomic weights of protactinium calculated are 230 4 and 230·8, the mean value, 230 6 or 231 ± 0 5, being in good agreement with Aston's mass-spectrograph results on actinium lead (AcD = 207) The compound $PaCl_5$, discovered by Grosse (*J Amer Chem Soc.*, **56**, 2200; 1934), might be more suitable for the precision atomic weight determination planned, but larger quantities of protactinium (which is now available for use in ordinary chemical manipulations) are desirable.

Chlorophyll

THE green colouring matter of plants is a wax-like material of complex chemical structure to which the name chlorophyll was given by Pelletier and Caventou in 1817. It is insoluble in water but soluble in alcohol, ether and other organic solvents Early investigations of chlorophyll which are important are those of Brewster and Stokes, on the absorption spectrum and fluorescence, and of Edward Schunck on the chemical side Schunck studied particularly the action of acids on chlorophyll and found that important changes in its physical and chemical properties resulted The first really fundamental investigations on the chemical structure of chlorophyll were those of Willstatter and his collaborators[1] which showed that there are two green pigments present in leaf green, namely, chlorophyll-*a*, with the formula $C_{55}H_{72}O_5N_4Mg$, a bluish-black solid giving greenish blue solutions, and chlorophyll-*b*, a greenish-black solid giving pure green solutions

On hydrolysis, chlorophyll yields an alcohol, phytol, $C_{20}H_{40}O$, which has been synthesised, and a complex containing four pyrrole nuclei, the composition of which has been determined by examining the decomposition products phytochlorin-*e* from chlorophyll-*a* and phytorhodin-*g* from chlorophyll-*b*, these two substances being usually called now chlorin *e* and rhodin-*g* By the action of acids on chlorophyll, a product free from magnesium, called *phæophytin*, is obtained, separable into two components, *a* and *b*. This in its turn, on treatment with hydrochloric acid, yields two phæophorbides, *a* and *b* By the further degradation of chlorophyll and its derivatives many products are obtained, known as porphyrins

Since Willstätter's pioneer work, the investigation of chlorophyll and its derivates has been continued mainly by Hans Fischer[2], who has carried out some important syntheses, and by J B Conant[3], and their collaborators. The results obtained by these two groups of investigators sometimes differ in points of detail[4] The present article has the object merely of recording some recent new work on the subject, the present position of which must be sought in the sources given in the references

A method which has been used in attempts to determine the relations between different substances is hydrogenation Dietz and Werner[5] now propose to discard this method as leading to very puzzling results difficult to reconcile with other reactions of the substances Thus, two porphyrins which appear to be isomeric, rhodoporphyrin and isorhodoporphyrin, differ by 0 8–1 2 molecules of hydrogen absorbed, whilst they are interconvertible in 50 per cent sulphuric acid at room temperature Transformation also occurs slowly in cold concentrated hydrochloric acid and more rapidly in glacial acetic acid with dry hydrogen bromide If the difference in hydrogen absorption is regarded as indicating a difference in hydrogen content, the acid transformations must be reductions, which seems very unlikely

The hydrogenation results show only a small difference between the chlorins and true porphyrins If these results are accepted, chlorophyll and the chlorins are to be regarded as dihydroisoporphyrins in basic structure and also isomeric with true porphyrins, as Fischer postulates The American workers, however, while continuing to assume that the fundamental nucleus of chlorophyll and the chlorins is that of a dihydroisoporphyrin, postulate that it is also that of a dihydroporphyrin, these being of an equal state of hydrogenation

A very interesting new method of attack has now been developed by Conant, Chow and Dietz[6], namely the potentiometric titration in acetic acid solution of the basic groups in chlorophyll derivatives The chlorophyll nucleus and those of its derivatives contain four pyrrole or modified pyrrole rings An important problem in connexion with the fine structure of the nucleus is the determination of the relative basicities of the four pyrrole nitrogen atoms, which add together to determine the basic character of the whole molecule. Willstätter had utilised the variation in basicity in the chlorophyll series in the method of acid fractionation, which made possible the separation of chlorophyll derivatives in solution, and had also obtained qualitative evidence of the greater basicity of two of the nitrogen atoms by the isolation of dihydrochlorides

Conant and his collaborators have now supplied quantitative evidence on this problem by a series of potentiometric titrations in glacial acetic acid using a chloranil electrode and perchloric acid as titrating agent, a method which had previously been studied[7]. This electrode makes use of an oxidation-reduction system similar to that in the quinhydrone electrode Chloranil and its reduction product provide the system in equilibrium with hydrion

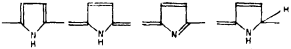
$$C_6Cl_4O_2 + 2H^+ \rightleftarrows C_6Cl_4(OH)_2 + 2\,\oplus,$$

and a *p*H scale can thus be derived from it When the solvent is glacial acetic acid, this *p*H scale will not, of course, be related directly to the standard hydrion activity as defined for aqueous solutions, but it may be defined in terms of an acidity function by a method discussed by the authors For comparative purposes this is a secondary consideration, and the values of *p*H in acetic acid may be calculated by a formula similar to that used for the quinhydrone electrode in aqueous solutions, a particular value being taken for the standard potential. If the reaction between chlorophyll base (B) and acid proton (H^+) is formulated as $B + H^+ \rightleftarrows BH^+$, the value of pK^1, the dissociation constant of the chlorophyll base, will then be given by

$$pK^1 = pH + \log (BH^+)/(B)$$

in which all symbols refer to the acetic acid solutions The *ionic strength* of the solution (which influences the activity coefficients of the solutes) was kept constant at $\mu = 0\ 2$ by adding the required amounts of the neutral salt trimethylammonium perchlorate The values of pK_1^1, pK_2^1 and pK_3^1, for the dissociation of the first, second and third basic groups, corresponding to titration mid points for each range, were read directly from the titration curves at added aliquots of 0 5, 1 5 and 2 5 mols of titrating agent, in accordance with the usual *approximate* theory for calculating *pK* from the *p*H titration values.

In this way, the values of pK^1 for a series of simple nitrogen compounds (positively and negatively substituted pyrroles, a dipyrrylmethane, two *N*-methyl methanes and a methylethylmaleic imide) were first determined These are all about $-2\ 3 \pm 0\ 3$, indicating that the pyrrole group is a very weak base If pyrrole is regarded as a substituted ammonia, the two α, β-unsaturated linkages appear to control the diminution in basic character of the ammonia nitrogen All the chlorophyll derivatives examined contain at least one and possibly two of the very weakly basic groups (*a*) or (*b*)



(*a*) pyrrole (*b*) isopyrrole (*c*) pyrrolenine (*d*) hydropyrrole

and they gave pK^1_3 values of - 1 9 to -2 4

With very few exceptions, all these compounds also contain one rather strongly basic group with a pK^1_1 value of +1 8 to +2 3, which, as titrations of two methenes indicated, was probably the oxidised pyrrole or pyrrolenine ring (*c*), having one α, β-unsaturated linkage and a tertiary nitrogen atom Pyridine has also a pK^1 value of +2 93, which is the lower limit of basic strength in the glacial acetic acid system This system gives satisfactory results for basic strengths of compounds such as urea, which have pK in water of about zero, and compounds so weakly basic (for example, acetanilide and acetamide) that they cannot be measured in water

The porphyrins stand out as a group from all other chlorophyll derivatives in containing *two* relatively strong basic groups, of average pK^1 of +2 5 The chlorins are differentiated from the porphyrins in having only *one* relatively strongly basic group, with pK^1 +2 1, and one group intermediate in basicity between the pyrrole and pyrrolenine groups, possibly an oxidation or reduction product of the latter in which the character of the nitrogen atom is changed The basicity of this group is influenced by substituent groups and is comparable with the basicity of urea and acetoxime This result leads to a correction of a previous formula for chlorin *f*, which is now supposed to contain a hydropyrrole nucleus (*d*) in place of one of the two pyrrolenine rings previously assumed by Conant

The true chlorophyll *a* compounds, the phæophorbides, are found to contain one relatively strongly basic and one very weakly basic group, as in the chlorins The intermediate group, however, is less basic than in the chlorins, but whether this difference is significant of a radically different structure is difficult to say In the *b* series, rhodin *l* is the simplest compound and corresponds with chlorin *f* in the *a* series The two basic groups in rhodin *l* are weaker than in the *a* series, but rhodin *g* is very similar to chlorin *e* Methyl phæophorbide-*b* is markedly different from the *a* compound in the relatively strongly basic group It appears that the extra oxygen atom in the *b* series affects the basicity of all the compounds, which would be unlikely if it were in the side chain of the propionic acid group, as postulated by Fischer

The interpretation of the results of the new potentiometric titration experiments is still incomplete and rather tentative, but it is clear that the method promises to throw light on the structure of compounds containing basic groups, and its extension from the chlorophylls and porphyrins into other fields is obvious

[1] Summarised in R Willstätter and A Stoll, Untersuchungen über Chlorophyll", Berlin, 1913

[2] Pedler Lecture, *J Chem Soc*, 245, 1934

[3] Many papers in *J Amer Chem Soc*, 1929 to date

[4] Critical summary of the literature by K F Armstrong, *Chemistry and Industry*, 809, 1933

[5] E M Dietz and T H Werner, *J Amer Chem Soc*, **56**, 2180, 1934

[6] J B Conant, B F Chow and E M Dietz, *J Amer Chem Soc*, **56**, 2185 1934

[7] J B Conant and T H Werner, *J Amer Chem Soc* **52** 4436 1930 J B Conant and B F Chow, *ibid*, **55** 3745 1933

Fuel Research in Great Britain*

THE work of the Fuel Research Board touches many aspects of the technology of fuel, and the annual report for the year ending March 1934 therefore provides a useful review of the problems before the coal and other fuel industries

In the first place, the report emphasises the steady accumulation of information by the survey of the coalfields of Great Britain, the value of which becomes increasingly evident as the demands on the properties of fuel become more exacting

Reference is made to the fall in demand for large lump coal in recent years Formerly, collieries made great efforts to avoid breaking coal because the consumer was prepared to pay, for size, a premium which was disproportionate to the calorific value of the coal itself Actually the consumer paid his premium for a fuel the cleanness of which was visible to the eye. Now more than 77 million tons of coal is washed and its quality can be guaranteed, irrespective of size Industrial fuel is nearly always wanted in small pieces, especially when firing is automatic The modern house has little room for storage, and the householder wishes to avoid the trouble and dirt of breaking coal One can foresee a time when the large lumps will become unsaleable, and already some collieries are seeking the best and most efficient manner of breaking down lump coal without the undue formation of dust Many difficult problems arise when coals are broken, such as the best treatment of wash water containing dust, and the staff of the Fuel Research Board is engaged on their examination

A section of the report deals with the liquid fuels from coal A small fraction of the needs of Great Britain is covered by the by-products of coal carbonisation, that is, benzole and coal tar oils Most of the liquid fuel is imported from distant parts where Nature has provided a bounteous though, from our point of view, ill placed supply of oil The geographical distribution of petroleum provides food for speculation as to what the distribution of man might have been had he known of the existence of the oil earlier, or had understood how to obtain, control and distribute the natural gas which accompanies oil in such abundance Industries might have been very differently situated, and it is improbable that men would have toiled against the hazards of coal getting if such an ideal fuel as methane were available without effort Even as it is, Governments all over the world are exerting themselves to turn solid into liquid fuels by processes which are technically speaking heroic but, judged by ordinary standards, uneconomic. The studies of the Fuel

* Department of Scientific and Industrial Research Report of the Fuel Research Board for the Year ended 31st March 1934, with Report of the Director of Fuel Research Pp vii+178 (London H M Stationery Office, 1934) 3s net

Research Board on this problem are interesting because so much of the experience in this field is in private hands.

It is shown that a large proportion of coal tars—indeed practically the whole of a low temperature tar—can be hydrogenated to first class motor spirit, and a larger plant for this purpose is being erected. As regards the hydrogenation of coal itself, the influence of minor inorganic ingredients is receiving special attention. Lubricants are not less important than the fuels and it is found that although some are obtainable from coal products, they are not yet suitable for common use.

Considerable attention is being given to the use of pulverised fuel at sea. The 'grid' burner for pulverised fuel devised at the Fuel Research Station is now in commercial use. Favourable reports are received of the use of pulverised fuel with this burner, and it is claimed to be, in general operation, equal to oil firing in similar furnaces, but more economical both thermally and in cost.

A new feature is the appointment of a 'scientific panel' of academic chemists, who are to engage upon *more academic investigation bearing on fuel processes.* The Board is also giving financial support, but unfortunately on a scale reduced in 1931, to other investigations in university laboratories. H. J. H.

University and Educational Intelligence

CAMBRIDGE.—R. I. N. Greaves, of Clare College, has been appointed University demonstrator in pathology. Dr. J. D. Boyd, of the Queen's University, Belfast, and R. S. Handley, of Gonville and Caius College, have been appointed University demonstrators in anatomy.

THE University Catholic Societies in Great Britain, twenty-three in number, are federated in an organisation which is linked with other national student federations through "Pax Romana", an international secretariat to which papal recognition was, for the first time, formally accorded last April. The British federation has marked its sense of the importance of this event by publishing in its Year Book for 1934–35 somewhat detailed expositions of its aims and policy and those of Pax Romana, and a report on a pilgrimage to Rome of a party of 130 of its members. Its general aim is to assist in the "Catholic education of persons of academic standing", the process being developed *pari passu* with secular studies and comprising, in addition to religious exercises, Catholic philosophy, Catholic social principles, Catholic missionary efforts and Catholic "action in the world at large". Further light on its outlook is to be found in the report, published in the Year Book, of the proceedings of its annual meeting held at Edinburgh on June 29–July 2, 1934. Here the general theme of the discussions was "The Catholic Approach to Knowledge", the chief contributions being papers read by Prof. G. Temple of King's College, London, on "Man and Knowledge" in which the supreme importance of metaphysics was urged, by Prof. E. T. Whittaker on "Man and the Universe" and by Mr. J. A. Lauwerys, of the University of London Institute of Education, on "Man and Life", in which he stresses, as in his book on "Education and Biology", a vitalistic point of view and the importance of teleology.

Science News a Century Ago

Social Economics

On February 16, 1835, a paper by Lieut.-Col. Sykes was read to the Statistical Society entitled "On the Increase of Wealth and Expenditure in the Various Classes of Society, as indicated by the Returns made to the Tax Office, by Exports, Imports, and Savings Banks". The classes included in this review were the gentry, the trading and manufacturing bodies and the depositors in savings banks, and the author gave some interesting particulars regarding the increase of capital employed in various articles of trade and luxury. The increase in population of England, from 1821 to 1831, he said, had been 11·3 per cent (from 11,760,555 to 13,091,005) and for the entire population of Great Britain and Ireland the increase had been somewhat more, from 21,726,924 to 24,306,719. In the same period, the poor rates had risen from £6,674,083 to £8,316,617. The total number of depositors in the savings banks was 475,155 and the amount deposited £15,715,111. In concluding his paper, Col. Sykes said it had been his object to offer a practical illustration of the facilities the Statistical Society afforded to everyone to collate facts with the view of showing the actual state and past changes in the condition of society.

Civil List Pensions for Men of Science

The recognition by the Government a century ago of eminent men of science led in the first place to the conferment of several knighthoods. It was next resolved to grant Civil List pensions. The first of these was awarded to Airy, then thirty-four years of age. On February 17, 1835, Sir Robert Peel wrote to Airy and in the course of his letter he said: "I consider you to have the first claim on the Royal Favour which Eminence in those high Pursuits to which your life is devoted, can give, and I fear that the Emoluments attached to your appointment in the University of Cambridge are hardly sufficient to relieve you from anxiety as to the Future on account of those in whose welfare you are deeply interested."

"The state of the Civil List would enable me to advise the King to grant a pension of three hundred pounds per annum, and if the offer be acceptable to you the Pension shall be granted either to Mrs. Airy or yourself as you may prefer."

"I beg you distinctly to understand that your acquiescence in this Proposal, will impose upon you no obligation personal or political in the slightest degree. . . ."

Airy replied from the Observatory, Cambridge, on the following day, thanking Sir Robert Peel, and asking that the pension might be settled on Mrs. Airy. Peel replied on February 19, saying: "I will give immediate directions for the preparation of the warrant settling the Pension on Mrs. Airy. . . . I assure you I never gave an official order which was accompanied with more satisfaction to myself than this."

Wheatstone on Musical Sounds

At King's College, London, on February 17, 1835, Wheatstone delivered an introductory lecture on musical sounds. A report of the lecture appeared in the *Athenaeum* of February 21, 1835. After showing how the oscillations of bells and string and wind instruments could be made visible, Wheatstone went on to the consideration of that modification of sound which constitutes its pitch, and showed that it depends on the frequency of vibration; he also explained the several modes by which this frequency could be estimated. He made experiments with Robison's stop-cock and Cagniard de la Tour's syren, and referred to the standard of pitch proposed by Chladni. He next dealt with the various experiments made with the view of determining the limits of audibility, with respect to the human ear, dealing particularly with those of Wollaston and Savart, and explained the origin and formation of musical scales. He concluded his lecture with an exhibition of Trevelyan's experiments on the vibration of heated plates, and a mode of producing sounds by an electromagnetic apparatus.

One of Faraday's Unsuccessful Researches

At intervals throughout the year 1835, Faraday worked on the preparation of fluorine. He had completed the long series of experiments by which he had laid the foundations of electro-chemistry, and had not yet begun his researches on electrostatics. In the course of his determinations of electrochemical equivalents, he had found that fused salts as well as aqueous solutions could be electrolysed, in certain cases with the separation of the elements in a free state; and he proposed now to apply the method of electrolysis to fluorides in the hope of devising a method of producing fluorine. Thus on February 19, 1835, the "Diary" records the construction of an electrolytic retort, of platinum, with electrodes of the same metal, in which experiments were begun on the electrolysis of fused lead fluoride. This research was unsuccessful as regards the production of fluorine. It came between two of his great periods of discovery, and was given up at the end of 1835, so that he might begin the electrostatic experiments with the great cube in the Royal Institution lecture theatre. It is of interest as an investigation which is described at some length in the "Diary", but of which no record appears in his published work.

The South Magnetic Pole

At a meeting of the Royal Society on February 19, 1835, E. Rudge read a paper "On the Probable Position of the South Magnetic Pole". The recent discovery of the site of the North Magnetic Pole, which had resulted from the experiments of Capt. James Ross, had suggested to the author the inquiry whether any similar indications of an approach to the South Magnetic Pole could be gathered from any observations then on record. With this view he gave a table of the observations made by Tasman in 1642 and 1643, during his voyage of discovery in the Southern Ocean, extracted from his journal. From this it appeared that Tasman on one occasion noticed the continual agitation of the horizontal needle, in south latitude 42° 25′ and longitude from Paris 160°. On the presumption that the South Magnetic Pole, said the author, was at that time near this spot, and that it had since been retrograding towards the east, he conjectured that it would now be found in or about the 43rd parallel of south latitude, and to the south-east of the Island of Madagascar, a situation extremely convenient for ascertaining its exact position, which he considered an object of great theoretical as well as practical importance.

Societies and Academies

LONDON

Royal Society, February 7. E. N. DA C. ANDRADE and P. J. HUTCHINGS: Mechanical behaviour of single crystals of mercury. In the mercury crystal the rhombohedral faces are glide planes, and the short diagonal is the glide direction. The crystal twins under strain on a plane through the long diagonals of two opposite faces acting as glide planes. In simple glide, twinning takes place when the twinning plane makes an angle of 45° with the axis of the wire. The rhombohedral face and the hexagonal basal plane are equally close-packed, but the former contains a much more closely packed line than does the latter. Double and triple glide can take place. Hardening on one set of glide planes hardens the whole crystal. The critical shear stress at −43° C. is 9·3 gm. wt. per sq. mm. E. N. DA C. ANDRADE and J. C. MARTINDALE: Structure and physical properties of thin films of metal on solid surfaces. The films were prepared by cathodic sputtering under carefully controlled conditions, with a water-cooled anode. The films obtained were uniform, and appear to be amorphous with all types of microscopic examination. When they are maintained at a temperature of about 230° for silver, and somewhat higher for gold, the first stage of crystallisation takes place, which consists in the formation of birefringement aggregates, of the order of 1 μ across, showing the spherulitic figure in polarised light. Prolonged heating at a somewhat higher temperature leads to rapid growth of the particles, which eventually become well-formed cubic crystals, all arranged with the (111) faces parallel to the supporting surface. The first aggregates are formed by the movement of the upper layers of the films, which are about 50 atoms thick, the further growth of the crystals being accompanied by the formation of areas from which the metal has retreated, leaving a thinner film. Crystallisation in such thinner films does not take place until a much higher temperature is reached than that required for the thicker films. M. BORN: On the theory of optical activity. This paper contains a detailed development of the theory of rotatory power given by the author in 1915. The molecule is considered as consisting of a set of isotropic oscillators coupled by Coulomb forces. The interaction is calculated by the perturbation method. The resultant formula is rather complicated but can be simplified very much for special cases. A molecule consisting of two equal pairs of oscillators perpendicular to one another and to their central line is worked out in detail; it gives the angle of rotation of the expected order of magnitude.

DUBLIN

Royal Dublin Society, December 12. KENNETH C. BAILEY: Thermal decomposition of hydrogen peroxide in presence of glass wool and copper sulphate. Hydrogen peroxide decomposes very slowly in the absence of suitable solid surfaces, even in markedly alkaline solution. In presence of glass wool, the decomposition is probably complex, and approximately correct results are obtained by using the equation $v = 15[H_2O_2]\,[OH']+7\times 10^{-6}\,[H_2O_2]$, the *amount* of glass wool present having very little influence on the velocity, although the stopping of the reaction in absence of solid surfaces suggests that both first and second order reactions are probably heterogeneous. In presence of glass wool on the surface of which copper has been adsorbed, the reaction is of zero order, and probably takes place in two stages, a peroxide of copper acting as intermediate compound It seems certain that this reaction follows an entirely different course from that on the surface of glass wool alone, copper ions in solution having little or no effect J LYONS The influence of physical and mechanical treatment on the firmness of butter. When the cream is cooled to a low temperature immediately after pasteurisation, it gives butter which is considerably firmer than cream which is not so cooled Pasteurising cream at unnecessarily high temperatures reduces the firmness The fat content of the cream used for churning and the moisture content of the butter and size of the fat globules in the cream appear to have little influence on the firmness The firmness of butter does not appear to be improved by holding it at a low temperature over a long period.

PARIS

Academy of Sciences, January 2 (*C R*, **200**, pp 1–100) JULES DRACH The logical integration of equations of dynamics with two variables Conservative forces Cubical integrals. Movements in the plane LOUIS BLARINGHEM The acclimatisation and degenerescence of varieties of brewing barley, *Hordeum distichum*. Discussion of the conditions necessary for the maintenance of the stability of hybrid barley MAURICE GIGNOUX and LÉON MORET The tectonic of the external border of the zone of the Flysch of Embrunais, between the Brac and the Durance (Piolit and Autanes massifs, Haute-Alpes) S JANCZEWSKI: The complex equations of Fredholm with uniform nuclei C POPOVICI The kinematic equilibrium ANDRÉ WEIL Almost periodic functions A DINGHAS · Remarks on two theorems of the theory of functions JULIUS WOLFF The conservation of the angles in the conformal representation of a domain in the neighbourhood of a boundary point FERNAND HOLWECK · Improvements in the elastic pendulum Recent gravimetric linkages between the reference station of the French network and that of neighbouring countries F PRUNIER · An experiment of Sagnac with a flux of electrons P LANGEVIN Remarks on the preceding communication ALBERT ARNULF · The resolving power of optical instruments as a function of the acuteness of vision N THON: The capacity of polarised mercury at very low frequencies After studying and eliminating certain sources of error, the author finds, contrary to the experiments of Erdey-Gruz and Kromey, that there is complete agreement between the capacities calculated starting with the cathode and anode polarisation. CHARLES HAENNY · The variations of the magnetic double refraction of cerous salts in solution. RAYMOND LAUTIÉ: Latent heat of vaporisation and characteristic temperature ARNALDO PERES DE CARVALHO: Contribution to the study of phototropy. Three new phototropic bodies MARCEL CHÂTELET · Some reactions of cobalt sulphate dissolved in glycerol MAURICE DODÉ. The study of the decomposition products of ammonium perchlorate. At temperatures less than 300° C, chlorine, oxygen, water and nitrous oxide are the main products of decomposition: at higher temperatures the reaction becomes explosive and nitric oxide appears in the place of nitrous oxide. JEAN CALVET: The annealing of pure aluminium and its possible utilisation as a criterion of the purity of the metal The samples studied ranged between 99 96 and 99 9986 per cent of aluminium, and the differences between the velocities of annealing are so large that a study of annealing after rolling into sheets forms a very sensitive test of the purity of the metal JULES GARRIDO The crystalline structure of manganite STOYAN PAVLOVITCH The action of heat on some natural oxides of manganese A. KAZMITCHEFF · The tectonic structure of the Cannes-Antibes region (Alpes Maritimes) PAUL FALLOT and LOUIS DONCIEUX The age of the Flysch of the periphery of the limestone chain of the Rif F LINK The density of the upper atmosphere calculated from twilight phenomena The theory of meteors of Lindemann and Dobson led to higher densities for the upper atmosphere than those generally accepted The author, using a totally different method, confirms these results JOSEPH DEVAUX Study of the albedo of snow in the infrared spectrum Starting with the band due to the water vapour in the air, melting coarse grained snow absorbs practically the whole of the solar radiation R BUREAU The foci of atmospherics and their localisation MLLE COLETTE GAUTHIER Singular reaction of a bean (*Phaseolus Mungo*) to a lesion of the seed EMILE MIÈGE The variations of the characters of seeds of elementary species of *Hordeum distichum* RENÉ HAZARD The action of sparteine on the inversion of the hypertensive effects of adrenaline by three phenoxyethylamines PAUL WINTREBERT The irregular mitoses of the vitelline merocytes in the course of embryogenesis of selacians (*Scylliorhinus canicula*) MAURICE PIETTRE, AUGUSTIN BOUTARIC and MME MADELEINE ROY The study of some proteins in aqueous solution GEORGES CRUT The comparative study of the action of hydrogen ions and of thrombase on the coagulation of fibrinogen J VELLARD and M MIGUELOTE VIANNA. Blood modification in cancer subjects treated with snake poison Study of the effects produced by small repeated doses of snake poison The necessity of extreme caution is emphasised

BRUSSELS

Royal Academy (*Bull Classe Sci.*, No 11) TH DE DONDER. The system adjoint to a linear system of partial derivatives of several unknown functions (2) CL. SERVAIS. Geometry of the tetrahedron (12) LUCIEN GODEAUX · Second order involutions of space A second order involution produced by a birational transformation of the seventh order, having a single fundamental curve of the first kind of order eight and genus five, first investigated by Montesano, is considered TH DE DONDER. Vortical gravific A gravific theory is developed in which the potentials $g^{\alpha}_{\alpha\beta}$ are antisymmetrical This *vortical* gravific completes the classical gravific constructed from symmetrical potentials, $g_{\alpha\beta}$, and furnishes a unitary theory of the electromagnetic field MARCEL WINANTS Solution of a problem in limits concerning the equation $\frac{\delta^2 z}{\delta x^2} = \frac{\delta z}{\delta y}$. M KOURENSKY: Integration of systems of partial differential equations of the first order containing two unknown functions of three independent variables YVONNE DUPONT: Electromagnetic couples and angular momenta in the gravific of Th De Donder (2) The antisymmetrical electromagnetic tensor is expressed in terms of the polarisation tensor and of the two electromagnetic potentials generalised by J Géhéniau. GEORGETTE

Schoules . Application of generalised statistical mechanics to the calculation of the entropy of gases with rigid molecules De Donder's generalised statistical mechanics is used to calculate the entropy of a gas of rigid molecules With the classical statistics the formulæ of Ehrenfest and Trkal are obtained The Bose Einstein and Fermi-Dirac statistics are also employed and a general formula for the entropy in terms of the energy is deduced M Bertrand Mechanism of pulmonary ventilation in the turtles The triphasism of the respiratory movements is caused by the occlusion of the glottis The expiration which precedes the central pause is purely passive Z M Bacq Physiological observations on the heart, the muscles and the nervous system of an ascidian (*Ciona intestinalis*) The chronotropism of the heart of *Ciona intestinalis* is not modified by non-toxic doses of adrenaline, acetylcholine or the ions of potassium, calcium and barium

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, February 17

British Museum (Natural History), at 3 and 4 30 —Dr Isabella Gordon ' Deep-sea Crustacea" *

Monday, February 18

British Museum (Natural History), at 11 30 —A C Townsend "The Linnæus Collection in the Library" *

Chadwick Public Lecture, at 5 15—(at the Royal Society of Tropical Medicine and Hygiene, Mansion House, 26 Portland Place, W 1) —Dr William A Robson · "A Hundred Years of Public Health Administration" *

University of Leeds, at 5 15 --Prof B Melvill Jones "The Stalling of Aeroplanes" *

Royal Geographical Society, at 8 30 —Major R E Cheesman "The Islands of Lake Tana"

Tuesday, February 19

Royal Horticultural Society, at 3 —Annual Meeting Lord Aberconway Presidential Address

Wednesday, February 20

Royal Society of Arts Lieut Col J D Restler "Water Supplies from Underground Sources"

Institute of Physics, at 8—(at the Science Museum, South Kensington) Informal discussion on "Modern Magnetic Materials and their Application"

Thursday, February 21

Royal Society, at 4 30 —Dr F W Aston "The Isotopic Constitution and Atomic Weights of Hafnium, Thorium, Rhodium, Titanium, Zirconium, Calcium, Gallium, Silver, Carbon, Nickel, Cadmium, Iron and Indium" J M Stagg "The Diurnal Variation of Magnetic Disturbances in High Latitudes"

Friday, February 22

Institution of Chemical Engineers, at 11—(at the Hotel Victoria, Northumberland Avenue, London, W C 2) —Thirteenth Annual Corporate Meeting.

W Macnab "Chemical Engineering in Explosives Manufacture" (Presidential Address)

Institution of Mechanical Engineers, at 5 30 —Annual General Meeting

Dr H E Merritt "Worm Gear Performance"

Institution of Professional Civil Servants, at 5 30—(at the Royal Society of Arts) —R A. Watson Watt : "The Cathode Ray Oscillograph" *

Royal Institution, at 9 —Prof A O Rankine · "Some Experiments in Gravitation and Magnetism".

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research Report for the Year 1933–34 (Cmd 4787) Pp iv+102 (London H M Stationery Office) 3*s* net

Department of Scientific and Industrial Research Report of Test by the Director of Fuel Research on the Plant of the British Coal Distillation Company, Ltd , at Newbold, Leicestershire, Test carried out 11th to 25th March 1933 Pp iv+29 (London H M Stationery Office) 9*d* net

Report on the Third Mycological Conference, 1934 Pp 32 (Kew Imperial Mycological Institute) 2*s* net

OTHER COUNTRIES

Denkschriften der Schweizerischen Naturforschenden Gesellschaft Band 69, Abh 2 Die Mittlere Kreide in den helvetischen Alpen von Rheintal und Vorarlberg und das Problem der Kondensation Von Arnold Heim und Otto Seitz, unter Mitarbeit im Felde von Siegfried Fussenegger Pp xi+185–310+3 plates (Zürich Gebrüder Fretz A G)

Publications of the Dominion Observatory, Ottawa Vol 12 Bibliography of Seismology No 3 July August September 1934 By Ernest A Hodgson Pp 47–64 (Ottawa King's Printer) 25 cents

Mysore Geological Department Bulletin No 15 Cummingtonite in the Limestones of Kudurekanave (Mysore State) By B Rama Rao Pp iv+36+7 plates (Bangalore Government Press) 1 rupee

The Coconut Research Scheme (Ceylon) Bulletin No 1 Report on the Soap Industry in Ceylon By Dr R Child Pp iv+45 (Lunuwila Coconut Research Scheme)

League of Nations Health Organisation Permanent Commission on Biological Standardisation Report of the Second International Conference on Vitamin Standardisation (London June 12th to 14th 1934) Pp 13 (Geneva League of Nations)

A Study of the Life History and Food Habits of Mule Deer in California a Contribution from the Wildlife Division, United States National Park Service By Joseph S Dixon (Reprint from California Fish and Game, Vol 20, Nos 3 and 4) Pp 146 (Sacramento California State Printing Office) 25 cents

Baltische Geodätische Kommission Sonderveröffentlichung No 3 Bestimmung der Längenunterschiede der Landeszentralen im Jahre 1929, 2 Die Berechnung der Längendifferenzen der Landeszentralen, von F Pavel Die Berechnung der Längendifferenzen der Landeszentralen, von Ilmari Bonsdorff Pp 49+91 (Helsinki)

Proceedings of the American Academy of Arts and Sciences Vol 69, No 11 New Bands of the Ionized Nitrogen Molecule By F H Crawford and P M Tsai Pp 407–437 60 cents Vol 69, No 12 The Relation of the Eyes to Chromatophoral Activities By G H Parker, F A Brown, Jr , and J M Odiorne Pp 439–462+1 plate 60 cents (Boston, Mass)

U S Department of the Interior Office of Education Pamphlet No 57 Aids in Book Selection for Secondary School Libraries By Edith A Lathrop Pp iii+28 5 cents Pamphlet No 58 The Economic Outlook in Higher Education for 1934–35 By Henry G Badger Pp 49 5 cents Bulletin, 1934, No 3 Economics through the Elimination of Very Small Schools By W H Gaumnitz Pp v+54 10 cents. (Washington, D C Government Printing Office)

U S Department of the Interior Geological Survey Bulletin 857–E Core Drilling for Coal in the Moose Creek Area, Alaska By Gerald A Waring (Mineral Resources of Alaska, 1932) Pp ii+155–173+plates 6–9 10 cents Bulletin 864–A Mineral Industry of Alaska in 1933 By Philip S Smith (Mineral Resources of Alaska, 1933) Pp ii+94 10 cents Professional Paper 185–A Studies on the Alkalinity of some Silicate Minerals By R E Stevens (Shorter Contributions to General Geology, 1934–35) Pp ii+13 5 cents Professional Paper 185–F A Lower Lance Florule from Harding County, South Dakota By Edward Wilber Berry (Shorter Contributions to General Geology, 1934–35) Pp ii+127–133+plates 25–27 5 cents Professional Paper 185–G Halloysite and Allophane By Clarence S Ross and Paul F Kerr (Shorter Contributions to General Geology, 1934 35) Pp ii+135–148+plates 28–29 5 cents (Washington, D C Government Printing Office)

University of California Publications in Anatomy Vol 1, No 7 On the Cutaneous Nerve Areas of the Forearm and Hand , their Sizes, Variations and Correlations studied in a Small Sample of Young Adult Males By I Maclaren Thompson, Verne T Inman and Bernard Brownfield Pp iii+195–236 (Berkeley, Calif University of California Press London Cambridge University Press) 50 cents

Proceedings of the United States National Museum Vol 83, No 2975 Some Fossil Corals from the West Indies By John W Wells. Pp 71–110+plates 2–5 (Washington, D C Government Printing Office)

CATALOGUES

Watson's Microscope Record No 34, January Pp 24 (London W Watson and Sons, Ltd)

A Catalogue of Books and Periodicals on Botany, Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Herbals, Tobacco (No. 499) Pp 94 (London Bernard Quaritch, Ltd)

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History Based on Science

A POWERFUL, learned and convincing book which has just appeared will, it is to be hoped, turn the minds of many people, besides readers of NATURE, to the consideration of the subject raised in the title of this article The book is the second volume of Prof Preserved Smith's "History of Modern Culture",[*] of which the first volume was noticed in these columns on April 4, 1931 (127, 515) We shall have something further to say about it later on The subject is the large one, still unrecognised by most thinkers in its true greatness, of the part which science has played, and is playing with increasing vigour as we write, in changing and building up the fabric of society

It is, of course, a commonplace that the discoveries and applications of science are the leading feature of our own age Some people deplore the effect of this development on ways of thought and life, others, like M René Sand, more justly, point out the enormous advantages to health and happiness which have already accrued to mankind from this source, and the illimitable supply which is at our command for the future, if we have the wisdom to use it No one disputes the fact But the strange paradox faces us, that, though this is admitted with regard to the present, the historians, those whose business it is to show how the present has arisen from the past, scarcely pay any attention to science at all Yet, surely, here again, we may start from two universally accepted truths; one, that the present is the child of the past and formed by it, two, that man is primarily the thinking animal, so that the history of his thought must be the most important part of his whole history In spite of this, the vast bulk of the history still taught and written deals exclusively with politics and war We are shown how men use and abuse their means of associating with one another We are not shown the nature or the growth of the one thing in which their association is most perfect, and by means of which they have gained their power of controlling the external world

Some people treat this as a purely academic question, to be settled by those who have the matter in hand Authors, they say, must study and write about the things that interest them and their readers. If people want the interest of chemistry, they will get it, and, surely, there are plenty of histories of chemistry? One cannot, however, just leave the question unanswered, for there is a thing called 'history' quite apart from the special histories of chemistry, art, religion, etc., and it is this general thing, called commonly 'history', to which we are now referring. It is that which forms the staple of what is taught in schools as 'history', and of which people think, when asked, if they care about history or know much about it. This common or general thing is made up almost entirely of politics and war, and it is this which statesmen and reformers now have in mind when they set up committees "to examine the historical textbooks and eliminate obnoxious matter" (as now in London), or commission writers to produce new history books, inspired by a certain desired spirit (as now in Germany). Evidently, the men who take this executive action think that there is something to be gained by doing it, and, though they probably exaggerate the possible effects of their action, we must agree with them when they find something more in history than the mere gratification of a special interest and treat it as a matter of profound social and intellectual concern. Unfortunately, however, those thus criticising and proscribing history books only deal, as a rule, with the fringes or excrescences of the matter. They only notice the special points obnoxious to their own point of view, and the root of the whole mischief escapes them.

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[*] A History of Modern Culture By Prof Preserved Smith Vol 2 The Enlightenment, 1687–1776 Pp. vii+708. (London George Routledge and Sons, Ltd., 1934) 12s 6d net.

The best proof of the truth which we are trying to establish—and incidentally the best evidence of the mischief of missing it—is to be found in works where the authors are clearly free from such propagandist intent as we have just instanced, and seem obviously trying to present the facts as they were. It happens that a book of great learning and bulk has recently begun to appear in England and has been received with a chorus of approval by the Press. This is Prof. A. J. Toynbee's "Study of History", of which the first three volumes appeared in the autumn and several more are promised. It is in many points similar to the more famous work of Spengler, and in the matter now under discussion is open to the same criticism. The general thesis, enforced by a wealth of interesting detail, is that history should be regarded as the record of the birth, flowering and decay of a large number of independent civilisations which we may indeed group into more or less cognate families, but which have their hour and pass away like the individuals who compose them. Prof. Toynbee has in fact a special section in which he denounces the 'misconception' of the 'unity of civilisation', while Herr Spengler, as is well known, has discovered and explains the decay and disappearance of the Western civilisation around which this unity is commonly supposed to rest and to be growing.

It is, of course, largely a question of terminology whether we speak of many 'civilisations' which pass away, or of one human 'civilisation' which lasts and grows. But there is one supremely important point involved in the belief in a real unity of civilisation, whatever the temporary varieties under which civilisation may appear in China, Egypt, Mexico and the rest, and it is just this one supreme point which the authors mentioned, and many more, completely miss. The unity of civilisation does not mean the temporary unification of a large part of the earth's surface whether by an Alexander, a Roman Empire, a Genghis Khan, or the colonising armies of modern Europe. It means that the root of human civilisation is *one*, and is to be found in the development of the human mind, which is similar all over the world in its effective contacts with external Nature, and of which science—understood in the widest sense—is the most characteristic and most permanent fruit. It is because science in this sense is missed by these theorists, and the hosts of others less learned than they, that we have all this talk about passing away of civilisation, the decay of the West, the bankruptcy of man.

If we study carefully the various features of the 'civilisations', described by Prof. Toynbee and others as having 'passed away', we find that they consist mainly of forms of art, language and literature, which naturally do attain a perfection of form and then decay or are transformed into other shapes. Thus Latin literature reached perfection with Virgil and then decayed. The renascence with Dante took a new form, though even here it would be too much to say that Virgil was dead. But science differs in this respect profoundly. It is not an art-form like a Greek vase or an ode of Horace. The changes made in its expression—systems of numeration, use of cipher, indexes, equations and so forth—are not comparable to the temporary laws of metre or to styles in architecture. They are rather progressive attempts to simplify the apparatus of thought, to make the common human mind more competent in ordering its thoughts and dealing with phenomena. Greek geometry or the Hindu cypher is not a fashion. It is absorbed permanently by mankind, and, though it may be further simplified or put into a still more general form, we all need to use it at some stage of our mental development

This comparative illustration is surely an apt one, and may be extended with due qualifications to science as a whole, which is constantly approximating to the precision of mathematics It is a common human possession, and a living and growing one, being in fact the best guarantee both of the unity of mankind and the future of civilisation Clearly, therefore, on all grounds, it should take a foremost place in our apprehension of history and in our presentations of it to others It is a difficult task, the most difficult perhaps in the whole of education , but it is scarcely too much to say that up to the present the attempts that have been made have either merely scratched the surface, or else burrowed so far below it that the work is not apparent to the mind of the average educated man History remains for the mass that story of political and military events (largely the latter) to which we referred above A book like that of Prof Preserved Smith is, therefore, heartily to be welcomed, for he has the root of the matter in him "Beginning," he tells us, "in the seventeenth century, men began to look forward and not back, to the future and not to the past, for the era of perfection The reason for this is simply the triumph of science By the end of the seventeenth century even the dullest could see that in knowledge of nature his contemporaries were superior to the most renowned of the ancient worthies "

Vol 2 of Prof. Smith's work covers the years from 1687 to 1776, and is called 'The Enlightenment', implying that awakening of the European mind to its possibilities which followed the scientific revolution of the seventeenth century True to his estimate of the relative value of the various factors in the intellectual evolution of the time, Prof Preserved Smith devotes his first section to science, the next to philosophy, the next to history, and so on It is a fairly complete and well-documented account of the intellectual output of nearly a hundred years preceding the French Revolution The author's reading is enormous, his style is clear and often pointed, and his quotations always apt and often amusing But, praise and enjoy it as we may, one cannot feel that we yet have the comprehensive and well-knit survey of history, inspired by science, which is the great desideratum This book is rather an interesting encyclopædia of a definite and important part of modern thought, full of profound reflections connecting one section of the picture with another, but not a forward-moving account of the whole as an expression of the growth of the human soul in that period, which the ideal requires There are so many trees in the forest, and we are so much interested in studying and comparing their shapes, that we tend to forget where it lies on the earth's surface and where it leads us The work of clear but sound synthesis in history still remains very largely to be done, especially in England, which is in practical ways the most historical of countries

In theoretical work of this kind we are now, as often before, outdistanced by others and perhaps most of all by the French This synthesis, the most needed for moral and international reasons, must be based on the subordination of other aspects of history to that of the growth of thought, and it will trace this growth from the humblest beginnings with the first ape-man to the conquering intellect which now embraces the universe

Reviews

Mathematics before the Greeks

Vorlesungen uber Geschichte der antiken mathematischen Wissenschaften Von O Neugebauer Band 1. *Vorgriechische Mathematik* (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, herausgegeben von R Courant, Band 43) Pp xii+212 (Berlin Julius Springer, 1934) 19.60 gold marks

MUCH work has been done during recent years in the decipherment and elucidation of ancient Babylonian mathematical texts, and most of all by Dr Neugebauer, the editor of this volume It is not too much to say that no such treasure trove has come into the possession of historians of mathematics since the year 1906, when Heiberg discovered in a palimpsest at Constantinople the tract by Archimedes called by him the "Method", which was supposed to have been lost

Since the publication of that work, other things have indeed come to light One is the solution by Archimedes of the problem of inscribing a regular heptagon in a circle , another is the Moscow papyrus acquired by the Museum of Fine Arts at Moscow in 1912 and at length published by W W Struve in 1930. But these things have added much less to our knowledge of ancient mathematics than the series of cuneiform texts the content of which is set out in the volume before us Dealing with Egyptian as well as Babylonian mathematics, Dr Neugebauer justly claims that his is *the first* attempt to give a comprehensive view of the history of pre-Greek mathematics, and we cannot be too grateful to him for his admirable exposition It is intended to be followed in due time by two more volumes ; vol 2 will deal with Greek mathematics, while vol 3 will treat of exact astronomy and particularly the classical work of Ptolemy on one hand, and, on the other, Babylonian astronomy of a relatively late date, the facts about which are much less accessible and more difficult to appraise

The present volume is divided into five chapters The first is on the technique of Babylonian numerical calculation (36 pages), the second (41 pages) contains a general historical account of the language and writing of the cuneiform texts, the Babylonian mathematical terminology, and finally the Egyptian hieroglyphic and hieratic scripts Chap iii (30 pages) describes the Babylonian and Egyptian numeral systems, the notation for whole numbers and fractions, and lastly the sexagesimal system of arithmetical notation and its development as a 'position-value' system of the most thoroughgoing kind Chap iv (56 pages) gives a general and complete account of Egyptian mathematics, the geometry of areas and volumes, arithmetic including fractions and their manipulation, and problems equivalent to elementary algebraical equations Chap v (42 pages) describes at length the whole content of Babylonian mathematics as it now appears in the light of all the texts so far investigated The headings include geometry, arithmetic and algebra Algebra includes linear equations with a number of unknowns, quadratics with one or two unknowns, and some cubic equations ; there are also some problems in simple and compound interest

Babylonian geometry is mostly the mensuration of areas and volumes (π is taken as 3, not such a good value as the Egyptian approximation); but calculations of the 'sagitta' of a chord of a circle by means of the lengths of the diameter and the chord, and the converse, involve the use of the Pythagorean theorem of the square of the hypotenuse The Babylonian arithmetic and algebra are far more remarkable, for the dates (about 2000 B C) to which the texts belong In arithmetic the sexagesimal scale is consistently used instead of the decimal; each number (up to 59) corresponding to our 'digit' means some power of 60; numbers are expressed as the sum of descending powers of sixty followed by units and then by successive sexagesimal fractions ; 'position-value' is fully secured by the existence of a sign, corresponding to our 0, to indicate the absence of a particular denomination. The Babylonians did not even trouble to specify any denominations ; they left them to be inferred from the context; thus 30 may anywhere mean $\frac{1}{2}$ as easily as 30 units, and so on. To divide one number a by another number b, they took the reciprocal of b ($1/b$), expressed it as a sum of successive sexagesimal fractions, and multiplied a by $1/b$ For this purpose they had tables of reciprocals, just as they had multiplication tables, the reciprocal of 1 21 (81 in our notation) is given as 44 26 40, which means in this case 0 44 26 40 (there being no units in the expression but only sexagesimal fractions) ; the product of 1 21 and 0 44 26 40 will be found to be 1

The Babylonians solved quadratics without stating any general formula, but they calculated the root in concrete figures precisely in accordance with the formula as given in our textbooks, the unknown quantities are not called x, y, z (or by any equivalent symbol), but they are the 'length', 'breadth', 'depth', etc, respectively in some geometrical figure Problems leading to some cubic equations constitute somewhat of a puzzle Some produce an equation of the form $x^3 + x^2 = a$, and the key to the solution in this case was discovered by Neugebauer in certain tables of numbers of the form $n^3 + n^2$ Other cases are not yet explained, and it may be that the root was known beforehand and the problem framed accordingly There are some approximations to the square roots of non-square numbers, one uses the approximation $a + (b/2a)$ for $\sqrt{(a^2 + b)}$, which is common in Greek mathematics In view of the Babylonians' proficiency in algebra about 2000–1800 B C, it is extraordinary that no *arithmetical* solutions of quadratic equations (as distinct from geometrical solutions) are found in Greek writers before Heron and Diophantus

In the account of Egyptian mathematics (chap iv), there is not much that is new in substance, but the exposition is succinct and comprehensive, and new points of view frequently emerge, especially with regard to the dexterous way in which the Egyptians manipulated their fractions, which (except for $\frac{2}{3}$ and occasionally $\frac{3}{4}$) were confined to submultiples and sums of such There is a useful discussion of problems 14 and 10 of the Moscow Papyrus, the first of which uses the correct formula for the volume of a frustum of a pyramid with square base, while the second purports to give the superficial area of a certain curved surface It is interesting to note that Dr Neugebauer inclines to Peet's interpretation of the language of the latter problem, which makes the surface measured to be a half-cylinder and not a hemisphere as supposed by Struve.

As a matter of printing, the volume is beautifully produced, altogether, it is a fine piece of work, and cannot be too strongly commended. T. L. H.

Animal Behaviour

he Behaviour of Animals an Introduction to its Study By Dr E S Russell Pp viii+184+6 plates (London Edward Arnold and Co, 1934) 10*s* 6*d* net

THIS small book is a model of its kind, providing, as it does, an excellent summary of the existing knowledge of animal behaviour, and being full of suggestions with regard to further profitable experimentation But it is more than a pleasantly written résumé, compiled by a man who obviously knows his subject and is intrigued by the many problems in this field which seem to defy human understanding It is a challenge to zoologists

With very few exceptions, animal behaviour is a study sadly neglected by professional zoologists in Great Britain, so neglected that its territory has been claimed by the physiologist and psychologist In this fact danger lurks, for, as Dr Russell argues, quite commonly the proper place for the study of animal behaviour is not the laboratory, and since the physiologist and psychologist are not necessarily naturalists, as the zoologist must needs be, the manner in which an animal lives and maintains itself in Nature has been almost completely disregarded

Dr Russell is perfectly justified in his view that *shepherds, fishermen, fanciers and sportsmen have* much of importance to tell the biologist, for those of us who know these men and have captured their interest are greatly indebted to them They have vast stores of accurate information which, properly examined, and freed from anecdote and conjecture, can be made to reveal matters of profound scientific value It is true that their interpretations may not, and usually do not, coincide with our own, but the extent of their knowledge of the habits of the commoner beasts and birds is astonishing They may know nothing of mechanisms, but they do know a great deal of the animal as a whole Thus it is that Dr Russell finds himself happy in their company, for he strenuously revolts against the purely mechanistic view and pleads for a return to the Aristotelian approach, according to which life and mind are regarded as continuous one with the other, the basis of the zoological system being the form and the behaviour of the animal as a single entity.

The author strongly emphasises the value to science of recording as fully as possible the normal everyday activities of animals, especially in the wild, of describing the objective facts in the simplest and most comprehensive way, disregarding all speculation about the animal's inner life, and studying only the overt and visible actions. Dr Russell teaches that behaviour is always directed toward some definite end, and is largely determined by its result, the action continuing until the goal is reached, that behaviour is often active or spontaneous in the sense that it is not a reaction to external stimuli, and that animals perceive an external world of their own Thus, in studying animal behaviour, the first question to be asked is What is the animal trying to do? The second To what exactly does it respond, that is to say, what does it perceive? The third How does its behaviour develop through maturation and through experience? Finally Is the animal's behaviour modifiable or adaptable?

The book considers these matters in some detail and illustrates the methods of simple, direct observation without theory and without analysis It leaves all questions on mind and matter to the philosophers It is addressed to students of biology and to the general public, and to these it can be strongly recommended Reading this book, one is driven to the conclusion that no zoological curriculum can be regarded as being complete unless it includes a course of animal behaviour given by someone with Dr Russell's knowledge and devotion to his subject

Embryology and Genetics

Embryology and Genetics By Prof T H Morgan Pp viii+258 (New York Columbia University Press, London Oxford University Press, 1934) 15*s* net

ONE of the most serious gaps in the whole structure of theoretical biology is the lack of connexion between the concepts of genetics and of embryology Both sciences have a peculiar importance for biology because they both deal with their subject matter in a particularly objective way The organism is not analysed along any of the lines worked out by the older physical sciences, but the path of analysis grows directly out of the reactions which are observed In this respect, genetics has been conspicuously successful, so that we can now, theoretically at least, represent an organism symbolically as a set of genes In practice, we cannot give a completely sufficient representation of an organism in this way, but we can often state precisely the way in which it differs from its fairly near relatives It is as though we knew the active groups of a complex organic molecule, but not the molecular nucleus

In genetics, one gene stands symbolically for a whole series of developmental stages, so that it may be said to determine a red eye at one stage, for example, and a black eye at another, like some of the genes discovered by Huxley and Ford in

Gammarus. It should be the province of embryology to lay bare the basis of such series and to find how genes interact to produce their final effects. This involves an analysis of the whole process by which a complicated adult organism is developed out of an apparently simple egg-cell, and has been found to be an extremely difficult task. As yet, experimental embryology has been chiefly concerned with the blocking in of the main features of the future organism, and has found itself dealing with characters which are not much affected by the genes described by geneticists, characters in fact which, to pursue the analogy mentioned above, seem to depend on the molecular nucleus in the formula for the organism.

There could be no one more fitted to explain the importance of these matters than Prof. Morgan, who is at once a well-known experimental embryologist and the foremost geneticist of his time. His book should appeal to a wide public, since although not entirely popular, it is written in a way which makes it comprehensible to scientific workers who have not previously taken particular interest in the questions under discussion. A general reader will find here one of the most lucid summaries of experimental embryological research into such questions as the development of isolated blastomeres or egg fragments, or the artificial production of twins. The results of those inquiries cannot easily be summarised, and an account of them therefore occupies more space than need be devoted to the clear-cut results of genetical experiments, which have led to a very few generally applicable hypotheses.

The confused mass of data obtained by the older experimental embryology is at last beginning to be put in order under the influence of the recent work of Spemann, who registered the first success in the attack on the fundamental problem of embryology. This problem is, I take it, the question of why a given part of the embryo develops into a given part of the adult, and Spemann's answer, that it does so because it is stimulated to do so by an organiser, is only the first crude beginning of the analysis, comparable to saying that a muscle contracts because it is stimulated to do so by a nerve. But crude though it may be, it is the best we can do as yet. The importance of having any answer at all, even if we have some doubts as to how widely it can be applied, is so great that it is primarily in connexion with these theories that we shall have to examine the relevance of the ideas of genetics.

Prof. Morgan, by a self-denying ordinance, rigidly denies himself all speculation on this subject, but indications are not lacking that it will soon be possible to attack the problem. Already there is the significant fact that when an organiser induces an organ, the reacting tissue develops its own peculiar specific characters. Seidel's demonstration that the activity of the *Bildungszentrum* in the insect egg depends on the interaction of the nuclei and the cytoplasm is another hint. We already know something about the action of genes which affect some of the better understood biochemical systems, such as the system which leads to the formation of pigment in some animals. It is probably not too much to hope that our knowledge of the chemistry of organiser action will soon develop to a similar level. But as yet we have no idea how to explain the action of genes which determine pattern. Some aspects of this, the most difficult problem of morphology, are considered fairly fully by Morgan, who gives us two chapters on the production of two embryos from one egg, or one embryo from two eggs. These two chapters, like the rest of the book, raise in a most fascinating way a series of important problems, at the answers to which Prof. Morgan is too cautious to guess in our present state of ignorance.

C. H. WADDINGTON.

Photo-electric Cells and their Applications

Photoelectric Cells: their Properties, Use and Applications. By Norman Robert Campbell and Dorothy Ritchie. Third edition. Pp. vii+223. (London: Sir Isaac Pitman and Sons, Ltd., 1934.) 12*s*. 6*d*. net.

THE third edition of this book is, as its authors point out, practically a new book altogether, though certain portions of the previous editions are retained without much alteration. The differences arise not so much from the new material which has become available since the last edition was issued—though this is considerable—as from a change in the balance of the treatment, and in the class of reader for which the book is intended. It is now less of a handbook for those who actually want to use photo-cells, or a textbook on the theory of the photo-electric effect, than a book for those who might want to use them, and do not object to a somewhat abstract method of treatment.

This edition is divided into three sections, dealing respectively with the properties, methods of use, and some of the applications, of photo-cells. The first section is that which differs most from the last edition. It starts with a moderately full, though not mathematical, account of the theory of the internal and external photo-electric effects and of rectification at thin films, based on the idea of stationary states for the 'free' electrons in metals and semi-conductors. This is followed by full and clear accounts of the properties of vacuum and gas-filled emission cells, of rectifier and of conductivity cells These are accompanied by a large amount of illustrative data given in the form of diagrams

The next section deals in a moderately detailed way with the manner of using photo-cells It starts with an abstract account of the principles of measuring instruments with special reference to photo-cells This is followed by two chapters on the measurement of the small currents which arise when the photo-cells are used with light of low intensity, and with valve amplification of the output from a photo-cell The modern four-electrode electrometer valve has replaced the valve bridges previously described, and mention is made of the use of the galvanometer in ballistic fashion The final chapter deals mainly with 'ticker' methods of measuring the current

The final section is called "Some Applications of Photoelectric Cells", and is the least satisfactory part of the book in that it gives the impression of being merely the summary of a much more extensive treatment of the various branches of photometry by means of photo-cells (May we hope for such a treatment as a separate book in the near future ?) It gives, however, a useful comparison of many ways of using these cells for the measurement of light intensities

The book is not quite free from misprints and slips of the pen, but these are few The printing and paper are an improvement on those of the last edition

Short Notices

Die Dreielektrodenröhre und ihre Anwendung Übungen an der Dreielektrodenröhre mit den zugehörigen theoretischen Erläuterungen Von Dr Friedrich Moeller (Abhandlungen zur Didaktik und Philosophie der Naturwissenschaft, Heft 15) Pp vii + 155. (Berlin Julius Springer, 1934) 9 60 gold marks.

Dr Moeller's book is designed for students, and it is a recommendation that it deals with the subject from both the theoretical and practical points of view. The object of the author is set out in his foreword . " the theoretical portion of the book can be looked upon as a text-book of the electron-valve, which attempts to explain the simpler problems of valve-theory without the necessity for special prior knowledge of A C technique"

The subject matter is divided into five main parts, and these are subdivided into 'Theory' and 'Practical' The parts deal with (1) the valve itself, and its properties, giving the definitions of 'slope', *Durchgriff*, etc , (2) triodes with resistance anode loads—amplification and power output , (3) triodes with tuned circuits, including H F amplification and self-oscillation , (4) modulation ; and (5) demodulation

It is felt that the author has undertaken a very difficult task in attempting to cover satisfactorily the theory of all this ground even to the extent required for a textbook of the triode for students, in a book of 150 pages , and when, in addition, space is allotted to practical experiments, some omissions are inevitable. Thus, although the book does cover a large part of the ground in a very thorough way (often, we feel, too thoroughly), a number of important problems are omitted or dealt with very briefly, and one is often left with a feeling of incompleteness The practical considerations are not always dealt with in the best way, and often digress into further theory.

Nevertheless, judged by the amount of information that has been included, the omission of advanced mathematics, and the suggestions for practical confirmation of results, the book should form a very useful addition to the series of scientific textbooks of which it forms the fifteenth volume, and should provide a good starting point for a radio student

The phraseology of the book is moderately straightforward, and anyone with a fair knowledge of the German language should have little difficulty in reading it, though the reasoning often seems unnecessarily involved, and the methods rather cumbersome Its value as a textbook and more so as a reference book would be improved by the addition of bibliographical references, there being at present only some half-dozen, and these to other volumes of the same series

Handbuch der Biochemie des Menschen und der Tiere Herausgegeben von Prof Dr Carl Oppenheimer Zweite Auflage Ergänzungswerk, Band 2 Pp xix + 961 (Jena Gustav Fischer, 1934) 71 gold marks

In a review of the last published supplementary volume to this work—1154 pages, in two half volumes, bringing vols 1, 2 and 3 of the second edition of the "Handbuch" up to the end of 1932—it was stated (**Nature**, **133**, 595 , 1934) that the volumes were of the type that filled "the user with awe-inspired gratitude and the reviewer with awe-inspired terror" A similar effect is produced by the second supplementary volume , it brings the main vols 4, 5 and 6 up to, presumably, the same date ; it occupies, with its index, nearly 1000 pages ; and it is apparently just within the 'single volume' limit

This makes it somewhat unwieldy, as well as somewhat unviable in the unbound form Still, the names of some of the contributors, Profs L Pincussen, J. Wohlgemuth, W. Grimmer, A. Scheunert, E Grafe —to select at random a few, none of whom contributed to the first supplementary volume—will almost certainly secure that the possessors of paper-bound copies hasten to get a volume of such obvious value put into boards as quickly as possible

The contents of this supplementary volume are divided in the following manner The supplement to vol 4 is concerned with the chemistry of tissues and organs, including blood and lymph, skeletal and epidermal structures, muscle, the apparatus of circulation and respiration, the nerves and sense organs, and the chemistry of tumours The supplement to vol 5 deals with the glands and secretory organs, which are classified into those involved in digestion and those involved in reproduction The supplement to vol 6 covers the general field of nutritional processes, including digestion, absorption and excretion Finally, vol 7 is brought up to date under the sub-headings of nutrition, gas exchange and general metabolism

It is clearly impossible to do more than indicate here in a quite general way the field surveyed in this book , the largeness of the field is in itself a measure of the vastness of territory mapped in the original work to which this is the second supplementary volume

A L B

Radio round the World By A W Haslett Pp vii + 196 + 7 plates (Cambridge At the University Press, 1934) 5*s* net

THIS volume presents an interesting account, in a form suitable for the layman, of the main facts accompanying the application of electric waves to radio communication A brief, historical account of the earliest discoveries of these waves includes a reference to the doubts and difficulties which accompanied the pioneer workers of some thirty years ago The story of the propagation of electric waves of all lengths round the world, by the aid of the ionised layers in the earth's atmosphere, is then developed in a straightforward and skilful manner A chapter entitled "The Sun calls the Tune" is noteworthy in this portion of the book, and directs attention to the various ways in which the possibilities of long distance radio communication are controlled or limited by solar influence

Later chapters utilise an account of the trend of modern developments to indicate the future possibilities of radio technique, particularly in the application of ultra short waves to secret communication for war purposes, to television, and, by no means least important, to the introduction of a new phase of curative medicine

On the whole, the author has obviously taken a good deal of trouble to get his facts correctly stated, although p 160 contains, in a loosely worded sentence, a bad misrepresentation of the possibilities of radio direction finding. A reviewer in another country might complain that in certain portions of the book undue stress is placed upon recent British work in radio research ; while in other places, the author has omitted to mention the Radio Research Board, from the publications of which so much of the material has obviously been derived These are, however, minor blemishes in an otherwise successful effort to show the general reader how very much more there is in the science and practice of radio communication than the mere dissemination of broadcast programmes.

Annales Bryologici a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr Verdoorn Supplementary Vol 4 : *Studien uber Asiatische Jubuleae (de Frullaniaceis 15–17) mit einer Einleitung Bryologie und Hepaticologie, ihre Methodik und Zukunft* Von Fr Verdoorn Pp viii + 231 (The Hague Martinus Nijhoff, 1934) 6 guilders

A SKETCH of the progress of hepaticology occupies the first thirty six pages , a knowledge of early authors is considered essential in questions of nomenclature and in dealing with types of genera , Evans, Howe, Lindberg, Schiffner and Spruce are authors favourably mentioned, but Stephani's "Species Hepaticarum" is very frankly criticised , its errors and other faults are considered to be so grave, that setting it aside as "opus excludendum" is discussed , in view however of its wide acceptance, that course is inexpedient and revision is recommended Improved methods, geographical, cytological, genetical, experimental morphological, etc , are urged in the study of liverworts , the weakness of much recent bryological literature is referred to Revision is the most urgent need of to-day , progress will largely depend on the study of the smaller groups, which are insufficiently understood

De Frullaniaceis xv xvii (pp 40 224) carries on work published in earlier supplements Dealing with the Lejeuneaceae, original diagnoses are reproduced as being often inaccessible to workers in Asia , there is a clavis to the fourteen genera, with notes on variability distinguishing characters, distribution and stations Section xvi is a revision of the Asiatic Tamarisceineae , a restricted but definite specific value is given to the Ocelli and a clavis to the six Asiatic species relies upon characters of the lobi, amphigastria and ocelli Section xvii deals with some recent collections and the distribution of Indomalayan Frullaniaceae and Holostipae

Strahlung und Lichterythem Von K W Hausser und seinen Mitarbeiten Herausgegeben von C Ramsauer und R. Kollath (Ostwald's Klassiker der exakten Wissenschaften, begrundet von Wilhelm Ostwald, neu herausgegeben von Wolfgang Ostwald, Nr 239) Pp iv + 89 (Leipzig Akademische Verlagsgesellschaft m b H , 1934) 4 gold marks

THOSE who knew the late Dr Hausser will find much pleasure in the fact that the memory of this brilliant young physicist, who died in 1933 at forty-six years of age, is honoured by the publication of his original papers on the action of sunlight on the human skin as one of "Ostwald's Klassiker" Hausser was a pioneer in this branch of biophysics, for he was the first to realise the importance of using monochromatic light of measured intensity in the investigation of the causes of erythema and sunburn, by means of his large quartz prisms He was responsible for the discovery of the fact that the human skin is particularly sensitive to two regions of the violet portion of the spectrum, one of which is normally absorbed by the atmosphere All interested in biophysics would do well to possess this little book

Radioactivity: Old and New*

By the RIGHT HON LORD RUTHERFORD, O.M., F.R.S.

I WAS much honoured by the invitation to give the first course of the Joly Memorial Lectures. As is well known, Joly was for many years not only intensely interested in the problems of radioactivity, but also made numerous original and important contributions to our knowledge of this subject. When the large and continuous emission of heat from the radioactive bodies was made clear in 1903, Joly's alert and original mind was at once attracted to the problem of the effect of this steady generation of heat by the radioactive bodies present in the earth's crust on the geological history of our planet. To obtain reliable data, he devised simple but ingenious methods for measuring the amount of the primary radioactive bodies, uranium and thorium, in typical rocks constituting the earth's crust. He was the first to point out the far-reaching significance of this small but steady supply of heat on the internal temperature gradient of the earth, resulting in violent movements in the earth's crust. Indeed, he was of opinion that the rise and fall of continents and the elevation of mountain chains were intimately connected with the heating effect of radioactive bodies over long intervals of time. A fascinating account of these bold and original ideas has been given by Joly in his books and papers.

Of all the contributions made by Joly in the field of radioactivity, the discovery of the origin of the pleochroic haloes, observed in certain kinds of mica, has left the strongest impression on my mind. It required not only an acute and original mind but also a touch of real genius to connect these minute haloes, the origin of which had long been a mystery, with the effects of radioactive transformations. Joly, as the result of an intensive investigation, was able to prove that the darkening of the mica halo was due to the α-particles liberated over ages from a minute inclusion containing either uranium or thorium. In a well-developed halo, a series of rings was observed, each of which corresponded in radius to the range of one of the groups of α-particles liberated from the radioactive material. In this way, he was able to show that the processes of radioactive transformation were the same hundreds of millions of years ago as to-day. In some very old micas, Joly observed an inner ring corresponding to α-particles of much shorter range than any observed from the known radioactive bodies. To account for it he postulated the earlier existence of an unknown radioactive element which he provisionally named 'hibernium'. The researches of Hevesy in the last few years indicate that this ring is probably due to a known element, samarium, which has recently been found to be weakly radioactive. These haloes are produced by an exceedingly minute quantity of uranium or thorium as an inclusion in the mica. Probably the emission on an average of one α particle every one hundred years continuing through geologic ages would give rise to a discernible halo.

I could give many more illustrations from other fields of inquiry which equally show that Joly possessed to a marked degree that rare quality of originality and vision characteristic of the greatest investigators of the past.

The property of spontaneous radioactivity is shown to the most marked extent by the heaviest elements, uranium and thorium, and the products which arise from their transformation. Only a few lighter elements show this property and those only to a feeble degree. We now know that the property of radioactivity is a sign of the instability of the atoms concerned. Take, for example, the best known radioactive element, radium. For some unknown reason, each second a minute fraction of the radium atom becomes unstable and breaks up with explosive violence, a fragment of the atom—an α-particle—being hurled out with high speed. As a consequence of these atomic transformations, a new type of atom is formed—the radium emanation—which in turn is unstable, breaking up rapidly with the liberation of an α-particle. The process of transformation once started proceeds through a number of successive stages, finally ending in the formation of a stable and non-radioactive isotope of lead. The successive transformations of uranium lead to the formation of twelve distinct types of radioactive element, and in all more than thirty of these radioactive elements are known. Each of these elements suffers transformation according to a definite law but at a different and characteristic rate. For example, radium is half transformed in 1600 years, the radium emanation in 3.82 days, and its succeeding product radium A in 3 minutes.

In most of the transformations, α-particles are alone expelled, but in a few cases the transformation is accompanied by the expulsion of β-rays, which are swift electrons. The mass of the atom is not sensibly changed by the expulsion of such a light particle, but the properties of the resulting atom are entirely changed. There is one important feature which distinguishes β-ray from α-ray transformations; all the α-particles escape with identical speed and thus the transformation of each atom leads to the liberation of an equal quantity of energy. In the case of a β-ray transformation, one β-particle is expelled per atom, but the speed of the β-particle varies widely from atom to atom. If this be the case, one atom loses more energy than another, and we should consequently expect the energy content of the new atoms formed to differ. There is, however, no evidence that such differences of energy exist, and indeed when an α-ray body is formed by a β-ray transformation, the α-particles are again expelled with identical speeds. This difference between α- and β-transformations raises great difficulties and no satisfactory explanation is as yet forthcoming. It has been suggested either that the conservation of energy cannot be applied to such β-transformations, or that some of the energy from the atom is carried off in the form of an undetectable particle of very light mass called the 'neutrino'. We shall see that the same problem arises in the transformation of radioactive bodies which can be produced by artificial methods.

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* From the first Joly Memorial Lecture delivered at Trinity College, Dublin, on January 28, 1935.

It is desirable at this stage to say a word about the nuclear structure of atoms. At the centre of each atom is a minute but massive nucleus which carries a resultant positive charge. This charge controls the number and arrangement of the electrons which surround the nucleus. The properties of an atom are thus defined by a whole number which represents the number of units of charge carried by the nucleus. This fixes the number and order of the elements, but we now know that there are many species of the same element, defined by its nuclear charge, which have different masses. The number of these isotopes of an element varies; some elements like aluminium are apparently simple, but others like tin have a dozen isotopes varying in mass over a wide range.

The appearance of radioactivity results from the spontaneous transformation of the minute nucleus of an atom. The expulsion of an α-particle carrying two positive charges lowers the charge on the nucleus of the residual atom by two units, while the expulsion of a β-particle raises it by one.

If we are to effect the transformation of an element, we must in some way alter its mass or its charge. This can be done by adding or subtracting a particle, whether charged or uncharged, from the nucleus. This is easy in imagination but difficult in practice. The most effective way so far found is the bombardment method, involving the entry of a foreign particle into the structure of the nucleus and in some cases leading to the loss of a charged particle from the nucleus. We shall illustrate these different types of transformation by considering a few of the simpler typical cases.

The first proof of the artificial transformation of an atom was given in 1919, when it was found that the bombardment of the gas nitrogen by fast α-particles gave rise to the liberation of a number of fast protons which could only come from a disintegration of the nitrogen nucleus. It is now clear that about one α-particle in 100,000 comes close enough to a nitrogen nucleus to enter its structure. The α-particle is captured and momentarily forms a new nucleus of charge 2 units higher and of mass 4 units greater. This newly formed nucleus is unstable and breaks up with explosive violence, expelling a proton in the process. The mechanism of the reaction is given below.

$${}_{7}\mathrm{N}^{14} + {}_{2}\mathrm{He}^{4} \longrightarrow {}_{9}\mathrm{F}^{18} \longrightarrow {}_{8}\mathrm{O}^{17} + {}_{1}\mathrm{H}^{1}$$

The resulting stable nucleus is an isotope of oxygen of mass 17, which we now know to exist in small quantity in ordinary oxygen. About twelve light elements can be disintegrated by α-particles, and in all cases protons of characteristic speeds are emitted; the general mechanism of the reaction is probably similar, leading in all cases to the emission of a proton and the formation of a new but stable nucleus of mass 3 units greater.

During the last few years, another important type of transformation has been brought to light in which a new and strange type of particle called the neutron is expelled. The neutron, as its name implies, carries no electric charge, but has a mass about equal to that of the proton. Since it has no charge, it does not ionise the gas in its path and consequently shows no track in an expansion chamber. At rare intervals in its passage through a gas, it hits the nucleus of an atom in its path and shoots it forward with high speed. This struck nucleus is charged and ionises the gas, so that its track through the gas is shown in a cloud chamber. While these 'knock-ons' are comparatively rare, they form a very convenient method of detecting the presence of the invisible neutron and forming an idea of its velocity. One of the best ways of producing a supply of neutrons is to bombard the element beryllium with fast α-particles. The α-particle is captured and the resulting nucleus of carbon 13 breaks up into a carbon nucleus of mass 12, while a fast neutron is expelled. The mode of the reaction is shown below.

$${}_{4}\mathrm{Be}^{9} + {}_{2}\mathrm{He}^{4} \longrightarrow {}_{6}\mathrm{C}^{13} \longrightarrow {}_{6}\mathrm{C}^{12} + \mathrm{neutron}^{1}$$

We are now able to produce neutrons in a variety of ways, not only by the action of α-particles, but also by bombarding different elements by protons and deuterons.

Still another striking type of transformation can be produced by α-particles, resulting in the artificial production of new radioactive bodies. In the transformations previously considered, the residual nucleus is a known type of stable nucleus, and is non-radioactive. A radioactive nucleus is an unstable type of nucleus which breaks up with the emission of fast particles, ultimately forming another stable nucleus. The production of an artificial radioactive body was first noted by M. and Mme. Curie-Joliot by bombarding boron with fast α-particles. After bombardment for a few minutes, the boron continued to show a marked activity for an hour or so after it was removed from the bombarding source. This activity decayed in exactly the same way and according to the same laws as the ordinary well-known radioactive bodies, but the type of particle emitted was quite different. Strange to say, it was found that high-speed positive electrons, or positrons, were emitted, and not α-particles or negative electrons such as appear in the spontaneous transformations of the radioactive bodies uranium and thorium. In order to account for the production of a radioactive element by bombarding boron with fast α-particles, it seems clear that the transformation occurs in two stages according to the scheme below.

$$ {}_{5}B^{10} + {}_{2}He^{4} \longrightarrow {}_{7}N^{13} + \text{neutron}^{1} $$

$$ {}_{7}N^{13} \longrightarrow {}_{6}C^{13} + {}_{1}\text{positron} $$

In the first stage, the α-particle is captured by the boron nucleus forming an unstable isotope of nitrogen, N^{13}, together with the liberation of a fast neutron. This isotope of nitrogen does not exist in Nature and is transformed slowly into the stable isotope of C^{13} by the expulsion of a positive electron. The activity of the radioactive body N^{13} decays to half value in about 14 minutes. By using the activity of this body as an indicator of its presence, it was shown by chemical methods that the radioactive body was an isotope of nitrogen. In a similar way, by bombarding other elements, radioactive isotopes of phosphorus and silicon could be formed, each with a characteristic period of decay.

This new discovery was rapidly followed up in a number of directions. Prof. E. Fermi and his collaborators in Rome found that a large number of these radioactive bodies could be formed when the elements were bombarded by neutrons derived from the action of α-rays on beryllium. On account of the absence of charge, the neutron is able to enter the structure of even a heavy element, where the α-particle on account of its charge is ineffective. Even the heaviest element, uranium, when bombarded by neutrons, gives rise to at least four new distinctive types of radioactive bodies, with half periods of 15 seconds, 40 seconds, 13 minutes and 100 minutes. The actual nature of the transformations involved has only been studied in a few cases. In all known cases, the neutron is captured; sometimes a heavy particle, an α-particle or proton, is emitted, but generally a higher isotope of the element is formed which may be unstable and emit negative electrons. It is worthy of note that all the radioactive bodies produced in this way break up with the liberation of fast negative electrons and not positive electrons, as in the original cases found by the Joliots. Cockcroft, Lawrence and others have found that bombardment of certain elements by fast hydrogen ions also gives rise in some cases to the production of new radioactive bodies.

It seems clear from these results that we are able greatly to increase our knowledge of the isotopes of the elements. None of these radioactive bodies are found in Nature, but represent unstable types of isotopes with a very limited life. During the last few months, it has been found that the efficiency of the process can be increased in some cases about a hundred times or more by slowing down the neutrons. This can be done by passing them through hydrogen or a solid material like water or paraffin which contains hydrogen.

We have so far spoken of the transformations brought about by the swift α-particles spontaneously expelled from radioactive substances, and the neutrons which arise from the bombardment of certain elements by α-particles. Another notable advance has been made by the use of bombarding particles produced artificially in the electric discharge and speeded up by appropriate methods. This involves complicated apparatus and in general the use of high potentials of the order of one million volts. In this way, copious streams of fast particles can readily be produced, corresponding in number to the α-particles expelled from thousands of grams of radium. Cockcroft and Walton were the first to show that transformation effects on a comparatively large scale could be produced by bombarding light elements like lithium and boron by fast protons. Time does not allow me to consider the mechanism of these transformations, which are different for each isotope of the same element. Transformation only appears to occur when the proton is captured by the nucleus, which then breaks up with explosive violence. Similar but different effects are observed when the ions of heavy hydrogen of mass 2 are used as bombarding particles. I would like, however, to refer to recent experiments in which it has been shown that artificial radioactive elements can also be produced by these new methods. Cockcroft and Walton and others have shown that ordinary carbon, whether bombarded by H^1 or H^2 particles, gives rise to the production of a new radioactive substance which decays to half value in about 11 minutes, emitting positive electrons in the process. It is believed that the radioactive body formed in both cases is N^{13}, which is transformed into the isotope of carbon C^{13} by the emission of a positron It is not yet settled whether this radio-nitrogen differs from that formed by α-rays, where the half period seems to be longer, namely, 14 minutes

It seems likely that when very intense streams of still swifter particles are available, radioactive bodies of strong intensity may be produced by these artificial methods It may be also that some of the bodies produced in these ways may give rise to a succession of changes such as is characteristic of the heavier elements uranium and thorium

Sufficient, I think, has been said to illustrate the extraordinarily interesting results obtained in this fascinating field of inquiry We can build heavier elements from lighter, and break up other atoms into fragments, and produce novel radioactive elements by the score This new field of what may be called nuclear chemistry is opening up with great rapidity Much work, often of a difficult technical character, will be required to prove the exact nature of any of the transformations which have been observed, but a very promising beginning has been made Future work may disclose many surprises, for new and unsuspected particles may come to light In any event, we are entering a no man's land with the ultimate hope of throwing light on the way atoms are built up from simpler particles

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A New "Nomenclator Zoologicus"

FROM the time that the tenth edition (1758) of the "Systema Naturæ" of Linnæus, which established the binomial system, was recognised as the basis of the nomenclature of animals, systematists have always had to face the difficulty of ascertaining what names have been used for genera Since the same name cannot be validly used more than once in the whole of zoology, it is obvious that unless this information is reasonably accessible, many homonyms are inevitably created and themselves add to the confusion Moreover, even when the existence of a name is known, it is often by no means an easy matter to find the original reference to it or to ascertain its position in the animal kingdom Before describing the situation at the present day, it may be as well briefly to review the attempts that have been made to solve these problems

The first Nomenclator to be published was that of Agassiz, which appeared between 1842 and 1846, it was followed by that of Marschall, which covered the period 1846–68 and was published in 1873. In 1864 there appeared the first volume of the "Zoological Record" which, however, in its earlier years, did not always include an annual list of new genera The names in all these, with many others, were collected together by Scudder, who attempted a list of all published genera from Linnæus to 1879, and his work, which was published in 1882–84 as Bulletin No 19 of the U S National Museum, is the only list of its kind that has yet been completed. It contains about 80,000 names Supplements to Scudder's work are represented by the two volumes, edited by Waterhouse and published by the Zoological Society of London, of the new genera contained in the "Zoological Record" with some additions. These volumes together contain some 62,000 names, and cover the periods 1880–1900 and 1901–10 respectively. The new generic names in the "Zoological Record", which average about 2,000 per annum, have not been collected together since that date

Sherborn's famous "Index Animalium", which was published between 1902 and 1933 and deals with both generic and specific names, though marvellously complete, only goes up to the year 1850 There also began to be published in 1926, under the auspices of the Prussian Academy of Science, an ambitious work entitled 'Nomenclator animalium generum et subgenerum" If circumstances had permitted this to be carried through as originally planned, it would have been a very important contribution to the problem for the period that it dealt with Though it appears to cover the ground with relatively few omissions up to about 1909 and it purports to include all names up to 1922, those dealing with the later years are taken almost entirely from the annual indexes to the "Zoological Record" The choice of the date 1922 was peculiarly unfortunate, because the "Zoological Record" was necessarily far from complete in the War years and those immediately following, with the result that it omits the very numerous names that were actually published during 1914–22 but were only found and recorded afterwards Furthermore, only about three quarters of this German work have yet appeared, although it has been nine years in course of publication Its use is therefore very limited, and it has the added disadvantage of being extremely expensive.

The present position is, therefore, that a systematist who wishes to erect a new generic name finds it almost impossible, even at the expense of much labour, to satisfy himself that any given one has not been used already. Not only are his sources of information very scattered and far from complete, but also many of them are rare and expensive

The Council of the Zoological Society of London has therefore decided to make financial provision for a scheme to produce an entirely new "Nomenclator", in which an attempt will be made to include every generic name used in zoology from 1758 up to and including 1935 It is estimated that this will involve about 190,000 names, of which about 100,000 relate to insects The names from 1758 to 1879 will be given their original references, these being taken, so far as those up to 1850 are concerned, from Sherborn From 1880 onwards, the "Nomenclator" will take the form of an index to the "Zoological Record" itself The class of animal concerned, or in the case of insects, the order, will also be given

A very intensive search is being made of the literature to discover names that have been omitted from existing records, and this has already resulted in the discovery of some seven hundred in insects alone, chiefly among publications that appeared between 1900 and 1920 It is hoped also to enlist the aid of all systematic zoologists throughout the world in making the work as complete as possible, and a circular asking for their help is being sent out In the course of this, they are asked to send details of any generic names, with their original references, to Dr S A Neave, of the Imperial Institute of Entomology, 41 Queen's Gate, London, S W 7, who is supervising the undertaking on behalf of the Zoological Society of London, and will also have the assistance, in particular groups, of experts at the British Museum (Natural History)

It is hoped that the work may be completed for publication about the end of 1937, and that it will be found possible to issue it at a moderate price

Solid Carbon Dioxide

IT is just a hundred years ago since carbon dioxide was first solidified by Thilorier Most chemists are familiar with carbon dioxide 'snow', which has long found use in the laboratory as a convenient means of producing temperatures down to about − 80° C The comparatively small quantities required for such purposes were obtained by the simple but wasteful method of allowing liquid carbon dioxide from a cylinder to expand through a valve into a collecting bag , in these circumstances less than 30 per cent of the weight of the liquid used is obtained in the form of 'snow'

Until about ten years ago, the solid was only used as a laboratory freezing agent, and also in small quantities medically as a cauterising agent For the latter purpose the 'snow' was usually pressed into a solid pencil in a mould, making it more convenient to handle, and, owing to the reduced surface exposed, less rapid in evaporation

The commercial development of the manufacture of solid carbon dioxide became a possibility only when refrigeration began to play a large part in the organisation of food supply. A great impetus was given by the rapid growth of the ice-cream industry in the United States, where the annual production (under the familiar name of 'dry ice') rose from a few tons in 1925 to approximately 27,000 tons in 1933. In Great Britain, production on a large scale commenced several years later, but it is estimated that the output in 1934 reached 10,000 tons, and demand for the product continues to expand.

In Great Britain, the gas for the production of solid carbon dioxide is chiefly derived as a by-product from industrial processes, such as the manufacture of synthetic ammonia, and in the production of alcohol Purification in greater or less degree depending on the source of gas is required in all cases, including the removal of odoriferous compounds and of inert non-condensable gases which, under certain conditions, and if present in sufficient quantity, would render the liquefaction of the carbon dioxide difficult or even impossible Following liquefaction of the gas, solidification may be brought about by various processes These, while relatively simple, are very interesting from the physico-chemical point of view , and their development on the most economic lines has been the result of much research on the phase rule and thermodynamic aspect of the system The process most commonly adopted is to allow the liquid to expand in suitable chambers with the formation of gas and 'snow', the latter being pressed into blocks of convenient size and shape, and the gas being returned for recompression In another process, the liquid carbon dioxide is expanded in chambers at a pressure just below that corresponding to the triple point, and solid blocks are obtained without the use of a press, while according to a third process the liquid is frozen in moulds by the rapid evaporation of liquid ammonia As might be expected, the several processes differ considerably in thermodynamic efficiency, although this is not reflected appreciably in the cost of production, power costs being only a small fraction of the whole

Solid carbon dioxide in its commercial form is available in blocks of cylindrical or rectangular section, weighing approximately 25 lb. These blocks have the appearance of highly compressed snow and may be cut without difficulty by means of an ordinary saw The temperature of the solid under a pressure of one atmosphere of carbon dioxide is − 78 9° C., but when exposed to the atmosphere is somewhat lower owing to the reduction of partial pressure of carbon dioxide near the surface of the block On account of the low temperature, gloves should always be worn when handling the solid In a still atmosphere, a block of the solid evaporates more slowly than might be expected, mainly on account of the low conductivity of the enveloping film of gaseous carbon dioxide and of the high latent heat of sublimation of the solid (137 cal /gm at − 78 9° C) Thus a 25 lb block requires about 24 hours to evaporate completely

The most careful measures have to be taken to prevent needless waste by evaporation both in storage and transport, and to this end heavily insulated storage bins have been designed in which the evaporation loss has been reduced to 0 5 per cent a day, while the evaporation in large railway transport containers is of the order of only 2 per cent a day Research into the most suitable types of container and insulating material has led to the development of a range of packages suitable for the transport of solid carbon dioxide, which enables this product to be sent from the producing centre to depots in all parts of the country, and thence to the user, with a very small total loss Although the solid can be stored for very long periods without serious loss, it has been found that a limit is set by the slow growth of the crystals, which tends to produce disintegration

As might be expected, the principal uses for solid carbon dioxide are in connexion with refrigeration Its dryness, high latent heat and high density (1 4) render it attractive in many cases where the cost of removing heat units is not the only consideration As already stated, the ice-cream industry was the first to adopt this refrigerant on a large scale in place of ice and salt mixtures, and the requirements of this industry continue to expand

A considerable field exists for solid carbon dioxide in connexion with the transport of perishables, such as meat, fish, fruit and flowers, where controlled temperature conditions are required As a result of the work which has recently been carried out under the auspices of the Department of Scientific and Industrial Research at Cambridge and at the Torry Research Station, and by other investigators, it is now known that carbon dioxide inhibits, in a marked degree, the growth of many of the bacteria and moulds which are largely responsible for the deterioration of meat and fish, so that the value of solid carbon dioxide as a refrigerant and preservative is further enhanced on this account. In preserving flowers, however, the effect is one of arrested metabolism due to the low temperature and the presence of carbon dioxide

It may be remarked that, although the successful utilisation of solid carbon dioxide as a refrigerant presents no serious technical difficulties, care must be taken in the design of equipment such as ice-cream conservators, refrigerated transport containers and the like, if this refrigerant is to be used successfully and economically

Except where the low temperature of solid carbon dioxide is specially required, means must be taken to reduce the heat flow to the refrigerant, and this can be done conveniently by interposing thermal insulation between the refrigerant and the cooled chamber A number of other methods employing a secondary liquid are available.

Reference has already been made in NATURE (Oct 6, 1934, p 529) to the use of solid carbon dioxide in the assembly of machine components by means of shrink fits The effect of the low temperature in contracting metal parts is best attained by immersing the parts in a suitable low freezing point liquid containing solid carbon dioxide In this way rapid and uniform cooling results The advantages of this method of shrink fitting are that it enables small components, such as cylinder liners, sleeves and valve seats to be readily inserted into housings without the use of a press, thereby obviating the possibility of distortion, and that the structure of heat-treated parts is not disturbed as might be the case with hot shrinking Solid carbon dioxide is already being used in Great Britain in the production of automobile and aero engines, locomotives and machine tools, and this application is likely to expand considerably as it becomes more widely appreciated

The use of solid carbon dioxide as a convenient means of obtaining a supply of the liquid or gas was first realised by Elworthy who, in a patent obtained in 1898, discussed the economic advantage to be gained from handling carbon dioxide in the solid form instead of as a liquid in heavy steel cylinders. It is only recently, however, that these advantages have been secured as a result of the development of solid carbon dioxide for refrigerating purposes, and the design of suitable containers and other apparatus. Pressure vessels ('liquefiers') are now available which enable the solid to be readily converted into liquid or gaseous form, and the use of solid carbon dioxide for purposes other than refrigeration is rapidly expanding. Foremost amongst these uses must be placed the carbonation and mechanical handling of beverages for which, it is needless to say, only solid carbon dioxide of the highest purity can be employed. For example, in 'Drikold', manufactured by Imperial Chemical Industries, Ltd, organic esters and sulphur compounds are reduced to less than one part per million, and any oil which may be carried over from the compressors is carefully removed in order to obtain a sufficiently pure product The solid is also finding increasing use as a source of carbon dioxide for the production of salicylic acid and other chemicals

Passing reference only has been made to some of the principal uses of solid carbon dioxide Certain other applications are still in the development stage, while others are constantly being discovered The development of the industry has been very rapid and constitutes one of the most remarkable modern examples of the application of scientific methods to industrial requirements.

Obituary

PROF ARTHUR THOMSON

ON his retirement in 1933, Prof Arthur Thomson, whose death on February 7 will be widely regretted, had completed a somewhat unusual record of academic service He was born on March 21, 1858, and for forty eight years he represented human anatomy at the University of Oxford, first as University lecturer in human anatomy and afterwards as Dr Lee's professor of anatomy After serving an apprenticeship in the famous school of anatomy at Edinburgh under Sir William Turner, Thomson went to Oxford in 1885 Unlike many of his later contemporaries, he did not enjoy the advantage of stepping into a department already equipped for teaching and research On the contrary, the task fell to him of building up a new department from its very foundations It will readily be appreciated that Thomson's energies were fully employed for a number of years in developing the teaching side of his department to a level appropriate to the medical faculty of the University of Oxford, a task which was rendered very laborious at first by the criticism and opposition of some members of the University who were less ready to appreciate the importance of catering for an extensive and detailed medical curriculum

Arthur Thomson's own contributions to scientific literature can be divided quite sharply into separate categories Of these, his papers dealing with the racial variations of the skeleton are the most noteworthy In this work he was clearly influenced by his late teacher, Sir William Turner, who had stimulated considerable interest in racial anatomy by his studies of the human skeleton in the *Challenger* Reports Thomson's work on this subject was characterised by the fact that he constantly sought to explain by reference to habits of life and environmental influences the osteological variations which were being at that time recorded by anatomists He was not content simply with measurements and with the construction of indices, and he was evidently reluctant to accept metrical variations of the skeleton as necessarily of real morphological significance in the assessment of racial affinities. In 1889 he showed the importance of considering posture as a factor in the determination of the proportions and contour of the lower limb skeleton and directed attention to the 'squatting facets' on the tibia and talus In the same year he published an anthropometrical study of the Veddahs of Ceylon. His interest in craniology led him to investigate the significance of cranial indices which were then assuming such importance in the eyes of the anthropologist By ingenious models he sought to show that the proportions of the calvarium must be directly influenced by brain volume and by the action of the temporal muscles These observations were published in the *Journal of the Anthropological Institute* in 1903, and his conclusions, which were admittedly tentative, have in some part been substantiated by statistical study on a larger scale

In 1913, Thomson made a valuable communication on the correlation of isotherms with variations in the nasal index Ten years later, this observation was submitted to statistical analysis by him in collaboration with Dr Buxton, with the noteworthy conclusion that a platyrrhine nasal index is associated with a hot moist climate and a leptorrhine index with a cold dry climate Other studies by Thomson in this line include a comprehensive study with D. Randall MacIver of Egyptian crania, published in 1905 by the Clarendon Press under the title of "The Ancient Races of the Thebaid", and a paper on the genial tubercles of the mandible in 1915 At Oxford, Thomson will be particularly remembered with gratitude for the part he played in instituting and organising the regular course of study for the University diploma in anthropology, a course which has met with increasing success since its initiation in 1907

Thomson was a close personal friend of the late R W Doyne, who founded the Oxford Ophthalmological Congress, and undoubtedly it was this friendship which led him to make special studies of the anatomy of the eye This resulted in the publication of two papers on the filtration angle of the eye in 1910 and 1911, and in a brochure on the anatomy of the human eye together with an atlas of stereoscopic photographs of dissections of the eye

Thomson's last work was concerned with the microscopic structure of the human Graafian follicle and the maturation of the human ovum These provided the subjects for two papers in the *Journal of Anatomy* in 1919.

Apart from his work at the University of Oxford, Thomson occupied the position of professor of anatomy at the Royal Academy, to which he was elected in 1900. In this sphere he was able to give full expression to his own artistic propensities, and he left an appropriate memorial of his contribution to art in his book "Anatomy for Art Students" which has passed through a number of editions

PROF J. MACMILLAN BROWN

WE regret to record the death of Prof. J. Macmillan Brown, chancellor of the University of New Zealand, and well known as an authority on the peoples of the Pacific, which took place at the age of eighty-nine years, at Wellington N Z, on January 18

John Macmillan Brown was born at Irvine, Scotland, in 1846, the son of Mr James Brown, shipmaster, and was educated at the Irvine Academy, the University of Glasgow, and Balliol College, Oxford, of which he was an exhibitioner In 1874, on the establishment of Canterbury University College, he went to New Zealand to take up the appointment of professor of classics, and later became professor of English literature In 1877 he became a member of the Senate of his University, and in 1923 was elected chancellor, an appointment which he held until his death

Macmillan Brown was best known in England for his work on the problems of the Pacific, and more particularly for his somewhat speculative theories on the origin of the Polynesians and of the remarkable artistic products of Easter Island His views were set forth in considerable detail and fully argued in his books "Maori and Polynesian", "The Riddle of the Pacific" (1924), and "Peoples and Problems of the Pacific" (1927) In the view put forward in the "Riddle of the Pacific" he argued that the famous statues of Easter Island are the product of workers on what was a mausoleum for a circle of islands, which have since disappeared owing to volcanic action. His theories of the peopling of the Pacific, which proved stimulating, if not entirely acceptable, brought the Polynesians as a Caucasic element from Asia, a primeval form of Indo-European. Whatever may be the ultimate verdict on his philological and ethnological theories, they undoubtedly had a stimulating effect in promoting the study of the peoples of the Pacific in New Zealand

MR FRANCIS J BLIGHT

OLD scientific friends of Mr Francis J. Blight will learn with much regret of his death at the age of seventy-seven years, on January 27 at his home at Mill Hill Previously to 1927 he had been closely associated with Messrs Charles Griffin and Co, Ltd., the well-known publishers of technical scientific books, and since 1899, when Miss E. E. Griffin died, he had been chairman and managing director of the firm, only retiring in 1927 in consequence of rearrangements following on the death of Miss Helen Griffin

In early life, Blight, whose father and grandfather had been booksellers and stationers, had been for some years engaged in office work connected with iron and steel works, railway and other architecture, map-making, etc. He had thus become an expert draughtsman, with a wide knowledge of technical processes of many different kinds In 1886 he became assistant manager to Messrs. J and A Churchill, the medical publishers, and in 1894 manager for Messrs. Griffin, then under the able chairmanship of Miss E. E. Griffin Quickly realising the wide need for technical scientific books of all kinds, he developed this side of the firm's business with extraordinary energy and success, bringing out textbook after textbook which had large sales

It was to a very great extent Blight's own personality that led to these books being written He not only suggested them in many cases to men who, he saw, were likely to write them well, but also in their actual production was extremely helpful, particularly perhaps as regards the illustrations It was an extraordinary stimulus and encouragement to meet him, as the writer of this short notice often did, in the well known room at Exeter Street which was pervaded by his genial presence

In 1920 a volume was published in celebration of the centenary of the Griffin firm, which had originated early last century at Glasgow This volume contains sections dealing with the more recent publications of the firm in scientific technology, and written by Prof. Barnett, Sir T Hudson Beare, Sir W. S Abell, Prof W. Gowland, Prof Henry Louis, and other well-known authors In a foreword to the volume, Lord Moulton stresses the national importance of technological publishing, and remarks that to Mr Blight "the exceptional prosperity of the Firm, and its services to the country during the late war, must be primarily ascribed"

Only brief mention can be made here of another side of Blight's life He was a keen supporter of the Baptist Church, and particularly of its charitable activities with respect to children and young persons He also strongly supported all that has been done in this direction by State action and municipal activity He was a man of simple character, in which love of his fellow men was never overshadowed by either business or scientific interests J. S H

MRS JANE LONGSTAFF, who died on January 19, aged seventy-nine years, contributed important papers on Palæozoic gastropod shells to the *Quarterly Journal of the Geological Society*. She was the widow of Dr G. B Longstaff, a well-known entomologist, with whom she shared a wide interest in natural history She was a fellow of the Linnean and Geological Societies, and was for some time a member of council of the Palæontographical Society Her early writings were published under her maiden name of Jane Donald, and the value of her researches was acknowledged so long ago as 1898, when the Geological Society awarded her its Murchison Fund

WE regret to announce the following deaths

Mr J. H Benyon, Lord Lieutenant of Berkshire and chancellor of the University of Reading, a leading figure in agriculture and stock-breeding, on February 14, aged eighty-five years.

Prof. Bohuslav Brauner, lately professor of chemistry in the Charles' University, Prague, sometime Berkeley fellow of Owens College, Manchester, on February 15, aged eighty years.

News and Views

Robert Hooke's Diary

THE tercentenary of the birth of Robert Hooke, Gresham professor of astronomy, surveyor to the City of London and curator of experiments to the Royal Society, occurs on July 18 of this year Hooke appears to have kept a continuous diary for the greater part of his life , and parts of his daily journal have been found in three different libraries The importance of the first part was realised by Dr Jean Pelseneer of Brussels, who directed the attention of the Royal Society to its existence in 1928 , with the permission of the authorities of the Guildhall Library, Mr H W Robinson made extracts, some of which were published by Dr Pelseneer in *Isis* (February 1931) Afterwards, Mr Robinson discovered another and later part of the diary in the British Museum, where for more than a hundred and sixty years it had been catalogued as the diary of James Petiver The Guildhall portion of Hooke's diary is the most important, and is full of interest from all points of view It records meetings of the Royal Society of which no minutes occur , elections of which there are no official records extant , details of his work as architect, surveyor and contractor , his daily visits to the coffee-houses and taverns, where he joined in the discourses and gossip of the city men , details of his private life, his income, his purchase of books and necessaries of life

BY the courtesy of the Library Committee of the Guildhall, the part of Hooke's diary in the Guildhall Library can now be published For many years Mr. H W Robinson and Mr W Adams have been carefully transcribing the diary, and it will be published, together with a short life of Hooke, by midsummer The work of printing and publishing has been entrusted to Messrs Taylor and Francis, who have undertaken to produce the book with the aid of a subsidy from the Royal Society Of more than passing interest is the fact that the house occupied by Messrs Taylor and Francis is supposed to have been built during the period of the diary, and most probably by Sir Christopher Wren and Robert Hooke It may be remembered that Dr R T. Gunther has already published three volumes of Hooke's works in his series of books on "Early Science in Oxford"

Tribal Justice in Australia

A PERTINENT example of the practical bearing of the results of anthropological investigation is afforded by the defence set up in a trial for murder of two aborigines from Alice Springs, South Australia. The facts of the case are set out in a dispatch from the Adelaide correspondent of *The Times* in the issue of February 15. The defence rested on a plea of tribal justice. It has been put forward that the two accused were acting in accordance with custom and under the instructions of the elders of the tribe in putting to death a man who had revealed ceremonial secrets to a woman. Failure to comply, it was stated, would have entailed death As might be expected, anthropologists have not failed in the endeavour to bring the aboriginal point of view before the court Expert witnesses, however, were not heard , but their special knowledge was placed at the service of the defence Ever since Spencer and Gillen first recorded, nearly forty years ago, the special reverence of the natives of Alice Springs for everything pertaining to tribal ceremonial, anthropologists would have been prepared to expect death as the logical consequence of so grave a threat to tribal safety as the breaking of taboo involved in the disclosure of ceremonial objects or procedure to a woman It is, at the very least, the equivalent of a combination of high treason and sacrilege in a civilised community As recent trials in Africa have shown, a court rooted in European law is not prepared to admit that in such cases tribal justice may demand and exact the supreme penalty, in the manner in which in a civilised society a traitor who discloses State secrets may be imprisoned for life or condemned to death. Those who carry out the sentence of the tribe must, in accordance with the laws of the country, be adjudged guilty of murder, even though the extreme penalty may not eventually be imposed

Organisation of Agriculture in Australia

DIFFICULT circumstances in the agricultural industries of Australia are giving rise to much-needed co-operation between Commonwealth and States In December last a conference of ministers at Canberra determined to establish an Australian Agricultural Council, to provide for continuous consultation among the Governments on economic aspects of agriculture, the members to be the Federal Minister for Commerce, the Minister in Charge of Development and Scientific Research and the State ministers concerned This body will be supported by a permanent technical committee which is identical in personnel with the former Standing Committee on Agriculture of the Council for Scientific and Industrial Research, but which will now have greatly increased responsibilities Its members are the six permanent heads of the State Departments of Agriculture, the three executive members of the Council for Scientific and Industrial Research, the Secretary of the Department of Commerce and the Director General of Health Besides its duties on the side of agricultural economics, this committee is charged with (i) securing co-operation and co-ordination in agricultural research throughout the Commonwealth ; (ii) advising Commonwealth and State Governments, directly or through the new Council, on matters pertaining to the initiation and development of research on agricultural problems ; and (iii) securing co operation between Commonwealth and States, and between the States themselves in all quarantine measures relating to pests and diseases of plants and animals, and advising Governments thereon

Training in Food Technology

THE Food Group of the Society of Chemical Industry met on February 13, at the London School of Hygiene and Tropical Medicine, to take part in a discussion on "The Training of the Food Technologist", opened by Dr H B Cronshaw, editor of *Food Manufacture*, the *Industrial Chemist* and other publications As Dr Cronshaw's paper had been circulated before the meeting, he gave a brief summary of the more contentious parts and showed a number of slides illustrating numerous institutions, chiefly in North America, at which research and teaching in food technology are combined to various degrees The main part of Dr Cronshaw's paper, however, and that which gave rise to most discussion, contained a plea for the introduction in Great Britain of special post-graduate courses in food technology at suitable universities and colleges Dr Cronshaw's paper included a comprehensive and very useful survey of the kind of problems with which the food technologist is likely to be confronted, as well as some ingenious classifications of the type of product with which these technologists have to deal For this reason alone its publication in full in *Food Manufacture* will be anticipated with much interest His main plea, however, was subject to considerable criticism by various members of the Society, particularly on the grounds that it tended to overemphasise the need of specialised technological knowledge in the young post-graduate entering industry, and so to run the risk of supplying him inadequately with the essential scientific outlook. Some of the discussion also directed attention to the importance of considering pre-graduate as well as post-graduate studies, and even of elementary and secondary education

Museum of the History of Science at Oxford

ON February 12 Congregation at Oxford unanimously passed the statute which alters the name of the institution housing the Lewis Evans and other collections of scientific instruments to the "Museum of the History of Science, Old Ashmolean Building". The first step towards the full recognition of this institution—hitherto governed by decrees—has thus been taken The museum is to be administered by the Vice Chancellor, the Proctors and six others, three of whom will be appointed by the science boards. At the moment there will be no extension of the premises. A decree, however, was also passed assigning the main ground-floor room of the Old Ashmolean to the museum at a date not later than 1942. This room, where in the past the New Oxford Dictionary was compiled, and the present upper-floor room, where the collections now are, should be adequate for the museum for many years. It is a pity, however, that this increased accommodation, at the moment badly wanted, cannot be definitely secured earlier, and that the University cannot promise adequate financial support for the staff in charge. It is to be hoped that such help will soon be forthcoming, so that the museum may take a bigger part in the science teaching in Oxford—an opportunity for a generous donor Congregation expressed themselves very appreciative of the work of Dr R. T Gunther, the curator, who not only created the museum single-handed more than ten years ago, but also has since given his services as administrator and teacher for a purely nominal salary

Pollution at Sea by Discharge of Oil

IN July last, the British Government, stating that representations had been made to it that the pollution of the coasts of the British Isles by the discharge of oil and oily matter outside the territorial limits by ships was increasing, suggested that the matter be referred for preliminary examination to the Communications and Transit Organisation of the League of Nations, with the view of concluding if possible an international convention At the last Assembly, this view was further explained by the British representative and it was decided that an initial inquiry should be undertaken Experts from Denmark, France, Italy, Japan, the United States and Great Britain were invited to Geneva by the chairman of the Advisory and Technical Committee on Communications and Transit These experts agreed that oil pollution caused the destruction of sea-birds, the wings of which become saturated with oil so that they cannot swim, fly or dive ; of fish, particularly shellfish, and of the marine grasses which form the staple food of fish and sea-birds. The pollution of sea-beaches by oil results in harm to bathers and depreciation in value of seaside resorts, and constitutes a menace to public health , finally, the accumulation of oil drifting into harbours offers a serious risk of fire. These evils exist to a varying extent in many countries and the object in view is to provide, by international agreement, some means whereby oil-burning and oil-carrying ships may be prevented from polluting, through the discharge of oil and oily mixtures on the high seas, the coasts to which the matter is liable to drift. Some causes of pollution such as collision, or the pouring of oil on to the sea during storm to assist vessels in distress, cannot be prevented, but it is possible by co-operation to guard against voluntary discharge outside territorial limits, and the Committee of Experts recommend that an appropriate international convention should be concluded.

Security of Tenure and Intensive Farming

THE private bill promoted by the Metropolitan Water Board, which may involve the destruction of Holly Lodge Farm (see NATURE of February 2, p. 177), was read a second time in the House of Commons on February 18. Sir A. Boyd-Carpenter moved that an instruction be given to the committee which is to consider the bill to leave out works on this site, on account of the unique value of the farm as a research centre. After discussion, Sir Hilton Young, Minister of Health, pointed out that he had consulted the Minister of Agriculture on the matter and it was agreed that the appropriate means of dealing with the question was to refer it to a committee of the House. Sir A. Boyd-Carpenter's motion was then by leave withdrawn. In a letter in *The Times* of

February 15, Sir William Prescott, chairman of the Metropolitan Water Board, stated that the "site for the proposed reservoir at Walton has been selected after the most exhaustive examination of other available lands". It is not stated whether the expert opinion available to the Ministry of Agriculture or to the Geological Survey has been sought, but it is much to be hoped that such scientific advice may be consulted before the matter comes under discussion in committee of the House of Commons.

A New American Balloon Ascent into the Stratosphere

FOLLOWING on the American ascent into the stratosphere last year recorded in NATURE of July 28, p. 132 and November 3, p. 707, 1934, careful inquiry has now shown that the mishap was caused by internal adhesions of the lower part of the balloon fabric. Plans for a new ascent are well advanced. The personnel of the advisory committee has been chosen by the National Geographic Society working in co-operation with the United States Army Air Corps, and once again Capts. A. W. Stevens and O. A. Anderson will ascend. It is gathered from the announcement by the president of the Society in the *National Geographic Magazine* of February 1935 that the arrangements will differ but little from those of last year's flight. The balloon will have the same capacity and the ascent will be made from the same place. No details are as yet available of the instruments that will be carried, but as the lifting power will be about six tons and as "special emphasis is to be placed on data that can be obtained from manned balloons capable of lifting standard laboratory instruments", there is no doubt that every possible self-registering device that might supply information about the upper atmosphere and cosmic rays will be included. An advisory committee under the chairmanship of Dr. Lyman J. Briggs, director of the U.S. Bureau of Standards, is to be congratulated on the thoroughness of its investigations of the previous failure. The findings will be of greatest value to those who undertake future hazards.

A New Diphtheria Prophylactic

OWING to the prevalence of diphtheria during the last year, a considerable demand has followed for immunising agents for preventive inoculation, which is now extensively practised with good results. Various agents have been employed for this purpose, such as toxin-antitoxin mixtures and preparations of modified diphtheria toxin known as 'toxoid'. An alum-precipitated toxoid (A.P.T.) of high immunising efficiency is now available, and is issued by Messrs. Burroughs Wellcome and Co., in germ-proof containers of 1 c.c. and 5 c.c. This substance was first prepared in the Wellcome Physiological Research Laboratories in 1926. The results of animal tests showed that it possessed considerable immunising power against diphtheritic infection, and since that date its high immunising efficiency in human beings has been established. Caution has been exercised in applying the inoculation of A.P.T. in human beings on account of the production of a tissue response at the site of injection. This, though medically trivial, may disturb parents of inoculated children. The efficiency of A.P.T. probably depends upon the deposition of the relatively insoluble aluminium-toxoid compound at the site of injection, and from this the immunising toxoid is gradually liberated. The complex toxoid compound, however, excites a tissue response in the form of a small painless nodule, and this tissue response is probably an essential factor in the potent immunisation that ensues. Unpublished experiments made in the Wellcome Research Laboratories have shown that in animals two spaced injections of one tenth, or less, of the ordinary human dose results in a more rapid, or a higher, immunity than one single larger dose. It is possible that a similar method may prove useful in human immunisation, the chance of troublesome local reaction being lessened by this course.

Juan Fernandez and Easter Island

BY a recent decree of the Chilean Minister of Lands and Colonisation, it is reported by a correspondent of *The Times* in the issue of February 14, Juan Fernandez and Easter Island have been declared national parks. This gives effect, so far as Juan Fernandez is concerned, to a proposal which was first put forward so long ago as 1921. The two volcanic islands grouped together under the name Juan Fernandez and situated four and five hundred miles respectively west of Valparaiso are of popular interest because it was on one of them that Alexander Selkirk was marooned from 1704 until 1709, and his adventure is supposed to have inspired Defoe in writing "Robinson Crusoe". Easter Island, on the other hand, which lies about 2,300 miles from the mainland, is one of the most interesting islands of the Pacific. Its archæological remains present a problem for ethnologists which hitherto has defied satisfactory solution. These remains consist of more than five hundred human figures, portrait statues, carved in stone, some of gigantic size and one at least approaching forty feet in height, over two hundred stone platforms and stone houses, unique in the Pacific, relics of a race of which the present inhabitants have no knowledge. Even more interesting in certain respects are the tablets inscribed in a script which no one has yet succeeded in deciphering. Since 1888 the island, which has an area of about 48 square miles, has been in the possession of Chile, and has served as a penal settlement. The native inhabitants, who are Polynesians with a Melanesian strain, barely exceed 200 in number, though in 1860 they numbered 3,000, but in the 'seventies a considerable proportion migrated or was removed to Tahiti and the Gambier archipelago. The decree of the Chilean Government, in so far as it will ensure the protection from vandalism of these unique relics of an otherwise unknown culture and an apparently vanished race, is a public spirited act worthy of the highest commendation.

A Tidal Power Project in the Bay of Fundy

THE Bay of Fundy is well known throughout the world for the height of its tides. It is not surprising, therefore, that Americans are interested in the project for getting tidal power at Passamaquoddy Bay, which lies between New Brunswick, Canada, and Maine, U.S.A. A full description of the project is given by H. E. M. Kensit in *World Power* of February. The projected power house is situated entirely in the State of Maine, but as the project is an international one, the power produced would be equally divided between the two countries. If we compare the estimated cost of the new project with that of the corresponding tidal power schemes in England (the Severn) and in the Argentine (San José) it comes out decidedly cheaper. In the English scheme, the cost of a horse power is £31·4, in the Argentine it is £25·3 and at Passamaquoddy it is £18·9, and each is roughly of the same size. The normal spring tides at the head of the Bay of Fundy range between 47 ft. and 52 ft. The maximum recorded tide occurred in 1869 and was nearly 57 ft. At the site of the new power station, the tides will lie between 17 ft. and 19·5 ft. In 1930, President Hoover induced Congress to defray half the cost of a joint investigation with Canada into the effect of such a station on fisheries. In this connexion, it is of interest to know that the committee on the Severn project decided that a large number of sluices open for many hours every day would obviate any detriment to fishing interests. It is probable therefore that the joint commission on fisheries may present a favourable report. The United States engineers indicate that there is no insuperable difficulty with regard to shipping interests, and many are hoping that this great enterprise will be carried out by private interests and capital.

Habits and Evolution

At the annual conference of the School Nature Study Union, held in January, Prof. E. W. MacBride was the speaker, and his address upon "The All-importance of the Study of Habits for the Knowledge of Evolution" was, in effect, a statement of his evolutionary faith (*School Nature Study*, 1935, p. 2). He led to his own viewpoint by a vigorous onslaught upon the faiths of others. Evolution we all accept, but the way thereof is dark. Darwin, we learn, with his natural selection of variations, was a false prophet, for natural selection does not work even if small deviations were heritable, which they are not. The mutationists are equally in error, for a mutation is a suddenly produced disturbance of development which persists only so long as the conditions producing it continue. According to Prof. MacBride, the truth lies with the neo-Lamarckians in their belief that use and disuse, in short habit, have been the mainspring of the progress of evolution. "Habit long persisted in does affect posterity and is the driving force in evolution; the personality, if we may use such a word, of a living being, is made up of a complex of inherited habits, and habits deeply ingrained are extraordinarily persistent." Prof. MacBride supports his thesis and trounces his opponents by quoting experimental results well selected for his purpose. Thirty years ago no biologist would have listened to the Lamarckian view; nowadays we are not so sure.

Scheme for Eradication of Cattle Tuberculosis

The Ministry of Agriculture and Fisheries has issued a document describing 'arrangements' made by the Ministry under Section 9 of the Milk Act, 1934, for promoting the establishment of cattle herds officially certified to be free from tuberculosis. Any owner who has taken steps to eradicate the disease from his herd, and is a 'registered producer' under the Milk Marketing Scheme, is entitled to apply to the Ministry for an official test of his herd, providing no reactors were found in the herd at the last two tests made under certain conditions on the owner's behalf. If the owner satisfies the Ministry as to the management and conditions of herd and farm, and agrees to observe the regulations, an official tuberculin test of the herd will be made by the Ministry free of charge, and provided no reactors are found, the herd will be placed upon a 'register of attested herds'. The scheme, which is a voluntary one, came into operation on February 1, and owners who desire to avail themselves of it should communicate with the Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, London, S.W.1. One advantage of attestation is that the owner will be entitled to a bonus of 1*d*. per gallon for all milk sold under the marketing scheme of the Milk Marketing Board.

Iodine and the Thyroid Gland

In the twenty-ninth Bedson Lecture delivered on February 8 in Newcastle, Prof. C. R. Harington dealt with the relation of the thyroid gland to iodine. He traced in detail the parallel histories of the anatomy, physiology and pathology of the gland, culminating in the work of Kocher, the treatment with sheep gland extracts by Murray, and the iodine treatment by Coindet of goitre and cretinism. Although the 3 : 5-diiodotyrosine also present in the 'colloid' must take part in the activity, as this is proportional not to total thyroxine but to total iodine, the two dipeptides made from them have not proved to show the full activity, so that possibly they are linked to, or by, other amino acids, it being fairly established that no other compound of iodine is present. The general picture, then, is as follows. Iodine is readily taken up by the gland with formation of 3 · 5-diiodotyrosine, which is elaborated into the globuline; this is the storage form, the so-called 'colloid', of the epithelial layer. When total iodine in the gland falls below 0·1 per cent, the colloid is soon exhausted and the epithelium extends to form goitre. Later, generally in pre-natal conditions, atrophy occurs leading to cretinism. Restoration of iodine at the former stage leads to distension by colloid, and the epithelium reabsorbs. In the normal state the tyrosine derivative is partly converted into thyroxine, and these two substances form the hormone which regulates bodily metabolism in general. In support of this view, it has been shown by Prof. Harington that the tyrosine and thyroxine are of the same stereochemical configuration by the preparation from each of thyronine (desiodothyroxin).

Ideal Home Exhibition

THE nineteenth *Daily Mail* Ideal Home Exhibition will open at Olympia, London, on March 26 A feature of the Grand Hall will be the great murals, 36 ft high and 374 ft. long, from end to end of each side of the hall The eighteen panels will bring to the eye, not only the vivid story of the changing world but also the actual features of more than a thousand men and women- pioneers, social workers, explorers, scientific workers, engineers, industrialists and others who have achieved distinction in helping to change the world for the better This work has been carried out to the original designs of Oswald Cuningham Among the features of the Exhibition will be a £50,000 installation of the very latest types of British-made canning machinery, weighing nearly 40 tons, to demonstrate the rapid strides made by this new home industry Twenty five years of progress in things engineering and scientific will be found on the second floor of the Empire Hall—the development of electric lighting, telephones, aviation, travel, transport, sound-recording, reproduction and radio The General Post Office will have in operation the latest of the many wonderful machines utilised in modern communications The strides made by 'staybrite' steel, which made its debut at the exhibition last year, will be demonstrated, and there will be numerous exhibits of beauty and utility for the home for furnishing, lighting, heating, decoration, labour-saving and recreation

Improving Long-Distance Telephone Transmission

THE rapid improvement of the technique of radio communication during the last ten years is now having a beneficial influence in the development of long-distance telephone transmission In particular, the improvements made in vacuum valves due to the demands made by broadcasting engineers have led directly to great improvements in the design of the repeater valves used in long-distance telephony It is well known that during conversation over long lines by means of carrier frequency equipment the sounds heard sometimes vary greatly in loudness This is attributed to the fact that the attenuation of the line, especially when overhead wires are used, changes with climatic conditions, temperature, etc With cable circuits, the loudness remains much more constant The phenomenon is analogous to the well-known phenomenon of '*fading*' in radio transmission Successful attempts have recently been made to mitigate this trouble A paper by H Sterky and R. Stalemark which appears in *Ericsson Technics*, No 3, 1934, describes an automatic method of compensating for these variations which has been used in practice for the last two years with good results. The development of the method is due to the telephone firm of Ericsson, Stockholm It depends on the well-known mathematical theorem that a carrier wave modulated by a wave of voice frequency is equivalent to three separate simultaneous oscillations. One of these has the frequency of the carrier wave; the others, called side-band waves, are of higher and lower frequency respectively In the Ericsson device, during conversation, the carrier and one side-band wave are transmitted Signalling is done by modulating the carrying wave with the 'ringing' current It is stated that the volume control of the sound obtained in this way is very good

Shellfish and the Public Health

THE Minister of Health has issued an Order, Public Health (Shell fish) Regulations, 1934, revoking previous regulations, and regulating the sale of shellfish for human consumption, which came into operation on January 1 The new regulations give powers to local authorities to investigate suspected layings, to prohibit the sale of shellfish from polluted layings, and to provide cleansing apparatus if considered necessary (Statutory Rules and Orders, 1934, No 1342 2*d* Circular 1446 1*d* H M Stationery Office)

International Office for the Protection of Nature

THE Belgian Government has by Royal decree officially recognised the International Office for the Protection of Nature, Rue Montoyer 21, Brussels, and has appointed the following delegates to be its representatives on the General Council of the Office Delegates for Belgium, Baron E de Cartier de Marchienne, Belgian Ambassador in London, and Count Henry Carton de Wiart, former Prime Minister , Delegates for the Belgian Congo and the Mandated Territory of Ruanda Urundi, P Charles, Minister of Colonies, and Prof V Van Straelen, director of the Royal Belgian Museum of Natural History and president of the Institute for National Parks in the Belgian Congo

Oxidation-Reduction Potentials in Bacteriology

THE fact that a second edition of Dr L F Hewitt's monograph on 'Oxidation Reduction Potentials" has been found necessary indicates the interest taken by biologists in the subject ("Oxidation-Reduction Potentials in Bacteriology and Biochemistry" published by the London County Council Pp 81 2*s*) Since the first edition was noticed in our columns (NATURE, **128**, 73 , 1931) the subject has advanced steadily, and the author has taken the opportunity to revise and extend the text and bring the bibliography up to date The study of electrode potentials is proving of assistance in the practical question of the rationalisation of culture media and cultural conditions and is throwing light upon the biological behaviour of organisms, such as the maintenance or loss of virulence, questions of great importance in medical practice

Improvement of Grassland

As much as eighteen million acres in England and Wales consists of grassland, and considerable attention has been paid in recent years to its improvement. The need for authoritative information on this important subject led to the publication of Bulletin No 3, "The Improvement of Grassland", by the Ministry of Agriculture and Fisheries, a fourth and revised edition of which has been issued (1*s*. net). The revision of the text has largely been carried out by Prof. J A. Hanley (Armstrong College, Newcastle-upon-Tyne) who has taken the opportunity of incorporating in the present issue the deductions drawn from the work done under the Ministry's 'Grassland Campaign', and also to include a section on the comparatively new system of rotational or 'managed' grazing. The sections on the renovation of worn-out grassland and seed-sowing remain substantially as written by Prof. R. G. Stapledon, of the Plant Breeding Station, Aberystwyth.

Medical Research in South Africa

THE annual report by the director, Sir Spencer Lister, of the South African Institute for Medical Research, Johannesburg, gives an account of the routine and research work of the Institute for the year 1933. Concentrated anti-plague serum, prepared in the Serum Department, has been tested experimentally, and has been found to have four times the protective and curative power of the unconcentrated serum, concentration being in the same ratio. Considerable difficulty has been experienced in maintaining the virulence of the plague bacillus in culture, and this difficulty has not yet been overcome. The study of pneumonia as it occurs among native miners of the Witwatersrand goldfields was continued, and the work confirms previous findings that the disease is not a pure pneumococcus pneumonia of the earlier days of the Rand, but that other organisms are associated with, or replace, the pneumococcus, namely, the streptococcus, staphylococcus and influenza bacillus. During the year, a case of human rabies due to a cat bite was observed; the incidence of human rabies infection is on the increase in South Africa, being conveyed by the cat, the tame meercat, and occasionally the dog. The observations upon dust estimation and control in the mines have been extended, and research upon several other subjects has been continued.

Astronomical Phenomena in March

MERCURY is now a morning object, and attains its greatest elongation of 28° W. on March 15. Venus, on the other hand, is moving round to its greatest eastern elongation (45° E. on June 30) and has already become a conspicuous object in the evening sky just after sunset. Mars is well placed for observation, being very nearly in opposition. Jupiter is a morning object, and Saturn is very near the sun. An interesting conjunction of Venus and Uranus will occur on March 22 at 7 hours, when the planets will only be separated by 0·4°. This conjunction will, of course, be invisible in England, but the two planets should be seen close together, in a small telescope, on the evening of March 21 or of March 22. Neptune is well placed for telescopic observation, being in opposition to the sun on March 4.

Announcements

PROF. W. J. DE HAAS, University of Leyden, informs us by cable that on February 15 he succeeded in reaching a temperature only five thousandths (0·005) of a degree above absolute zero. Particulars of this remarkable achievement will be awaited with great interest.

AT the annual meeting of the Royal Society for the Protection of Birds to be held at the Westminster Palace Rooms, 44 Victoria Street, S.W.1, on Friday, March 1, Her Grace the Duchess of Portland, president of the Society, in the chair, a motion will be submitted "That the Governments of all maritime nations be urged to give the strongest possible support to the League of Nations in their endeavours to secure the universal adoption of effective measures for preventing the pollution of the seas by oil".

IT is proposed to hold an exhibition of English periodicals and reviews in the library of the University of Coimbra, Portugal, early this year. It is hoped later to transfer the exhibition to Lisbon, Oporto and Braga. It appears that English is the second foreign language in Portugal, and a large proportion of its inhabitants have a working knowledge of the language; but there is a general ignorance of what periodicals and reviews are published in English. It is hoped that the exhibition will remedy this state of affairs. Further information can be obtained from the Director, Biblioteca da Universidade, Coimbra, Portugal.

REFERRING to Mr. C. R. Cosens's letter in NATURE of January 12 (p. 71) on "Designation of Logarithms to Base e", Dr. J. Satterly, of the University of Toronto, writes: "Long ago I decided that logh was too long and $\log_{10}$ and $\log_e$ awkward and have recently designated for blackboard work common logarithms and natural logarithms as 'ln' and 'lc', pronounced something like 'Ellen' and 'Elsie' respectively."

A BOOKLET dealing with the chloramine group of antiseptics has been issued by Boots Pure Drug Co., Ltd., Station Street, Nottingham, from whom it may be obtained free of charge. Attention is directed to the use of 'chloramine-T' and 'dichloramine-T' in the treatment of infected wounds, and to 'halazone', a most satisfactory chlorine compound for the sterilisation of drinking water.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A computer (class II) to the Ordnance Committee, Royal Arsenal, Woolwich, S.E.18—The Secretary (Feb. 25). A lecturer in electrical engineering at Chesterfield Technical College—The Director of Education, County Education Office, St. Mary's Gate, Derby (Feb. 25). A University lecturer and a part-time University lecturer in the Faculty of Mathematics, University of Cambridge—The Secretary to the Faculty Board of Mathematics, St. John's College, Cambridge (March 2). Junior scientific officers in the Aerodynamics and Radio Departments of the National Physical Laboratory, Teddington—The Director (March 4). A resident lecturer (chemistry or physics) at Girton College, Cambridge (March 6). An assistant lecturer in zoology in the University of Bristol—The Secretary (March 11). A Henry George Plummer fellowship in pathology at the Imperial College of Science and Technology, Prince Consort Road, London, S.W.7—The Rector (June 17).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 310.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Deep Diathermic Effect and Localisation by Means of 'Auxiliary Dielectric Electrodes' in the Condenser Field

AT present it is impossible to heat the deeper parts of a body of uniform transverse section and homogeneous structure to a higher temperature than its peripheral parts by means of high-frequency currents. With present-day methods the loss of oscillating energy by leakage and radiation is so great that probably less than 20 per cent of it is used for heating effects. Further, it is impossible to localise, to concentrate or even to direct the field more than very vaguely. Any object brought into the field deforms it in an uncontrollable way.

I have found a method by which the condenser field can be made to produce a greater effect at the deeper parts than at the peripheral parts by the use of 'auxiliary dielectric electrodes'. Between the two metal plates, of 2–3 in. diameter, of the high-frequency apparatus is placed a glass tube, about 4 in. long and half an inch in diameter. Near one end is a side tube for filling. The ends are closed by flat glass walls. An air space of ¼ in. is interposed between the metal electrodes and the glass ends. The tube is filled with white of egg. On exposure to the field, coagulation commences at the middle of the tube and gradually extends towards the ends, which remain cool. The coagulation does not occur if the long axis of the tube is parallel to the electrodes. If in this position suitable cylindrical auxiliary dielectric electrodes, one to two inches in diameter, made of agar, wax, ebonite, etc., be placed so as to occupy the space between the metal electrodes and the tube and be in contact with electrodes and tube, then coagulation occurs in that part of the tube which lies between the auxiliary electrodes. If we arrange the tube again lengthwise and apply a short dielectric cylinder to one end, a longer one to the other, the point of coagulation will be moved towards the longer dielectric. Different shape or different material of one dielectric may modify this effect.

A similar experiment can be performed with minced muscle, liver, kidney, etc. In some experiments it was possible to heat a 580 gm. piece of ox-liver to a considerably higher temperature in the centre than at the borders. For example, thermometers 0·6 in. from each side, and a thermometer in the middle and so 2·5 in. from the sides, registered as follows:

	Left edge	Centre	Right edge
Starting temperature	12°	9°	11°
After 10 minutes	15·8°	15·6°	15°

At this time the temperatures throughout the piece might be considered as equal. The room temperature was 18·5°. The following temperatures were reached:

After 10 minutes	19·6°	23·3°	18·3°
After a total of 60 minutes	31·7°	40·7°	31·2°
Total rise	19·7°	31·7°	20·2°

Of course, in the living animal such differences will scarcely be obtainable, except in quite special circumstances, on account of the considerable heat convection by the circulating blood and lymph. The effect is nearly the same for any wave-length between 3 and 30 metres.

These experiments prove the possibility of deep-heating, of localising and of concentrating the lines of force and of directing the field. A further advantage is the considerable reduction of the losses by leakage and radiation; the loss in the dielectric itself depends on its transparency for these waves.

Differences in the size of cross sections of different parts of the object cause an increased heating effect on the site of the smallest sections, and prominent points or corners sometimes heat up quickly. This inconvenience can be overcome by moulding the dielectric substance around or partly around the smaller cross sections, so that they are artificially increased. In that way it is possible to heat equally through a cross-section situated anywhere by leaving this section free and moulding dielectric substance round the other parts of the object. This produces a localised heating of the whole section, for example, an elbow or a knee.

The greatest difficulty in human application is the apparent necessity of electrodes of bigger size than the object. Not only is the relation of the size of the electrodes to the object important, but also the relation between the length of the object to its cross-sections. This can be corrected to a great extent by suitably shaped auxiliary electrodes. Recent experiments seem to show that it is sufficient if one electrode only is bigger; and if one does not wish to reach a higher temperature in the centre than near the surface, then two small electrodes are sufficient for a practically equal heating.

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Jan. 16.

Well Gauges as Seismographs

A NUMBER of workers[1] have noted that distant earthquakes are registered on automatic water stage recorders operated on deep wells. In each of these cases, the time scale was so small that the earthquake record was merely a thick line transverse to the direction of time movement. We recently fixed a gauge in a well at Lodi, California, with a Bosch-Omori seismograph drum, rate 15 mm./min., and smoked paper recording. The well is known as 3612A2. It is located at lat. 38° 07′ 38″ N., long. 121° 16′ 29″ W. in the Mokelumne area of the San Joaquin Valley. It is of circular cross section, diameter 6 in., depth 76·0 ft. below ground surface which is at an altitude of 46·9 ft. above mean sea-level. This well, which is not cased below the water surface, is in unconsolidated alluvial deposits of

Pleistocene and Pliocene age. It presumably penetrates to a confined aquifer or aquifers No log is available. The gauge is composed of a copper float, 4⅛ in in diameter, which operates a stationary 8 in. float-wheel by means of a cord and counterweight A 4-in diameter axle mounted on the float-wheel shaft is connected at its upper periphery by a copper ribbon to an auxiliary wheel in the same plane and at the same elevation, on the other side of the recording drum, tension in the ribbon being maintained by a second counterweight below the auxiliary wheel. An aluminium stylus attached to the copper ribbon thus moves horizontally a distance equal to one half that which the float moves vertically This stylus records on smoked paper on the drum. The minutes are marked on the record by means of a pendulum contact-making clock (supplied by Spindler and Hoyer with Bosch-Omori seismographs), actuating a relay circuit coupled to a solenoid, which energises the magnetic counterweight. Thus the stylus is displaced each minute. The clock correction is obtained daily.

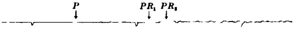

FIG 1

On November 30, 1934, at about 2h 05m 12s, G.M T , an earthquake occurred with epicentre at 18 5° N , 105° W , as placed by the Jesuit Seismological Association This was the first shock to be well recorded on the Lodi well gauge. The record is reproduced in Fig 1 The epicentral distance of Lodi was about 25°. The *P* phases were all recorded, the reflections PR_1 and PR_2 particularly well The *S* waves were not distinguishable At the Berkeley station (epicentral distance 25°) the Bosch-Omori seismographs (static magnification 40) wrote an excellent record of this shock The amplitudes of the *S* waves were about four times those of the *P* waves. Some workers have hesitated to say definitely that the second preliminary or *S* wave is a shear wave. It appears that its failure to record on the well-gauge establishes definitely that it is an equivoluminal wave, since it is to be expected that only waves involving change in volume, and hence hydrostatic pressure, will affect the water-level More sensitive recording apparatus may eventually reveal some small motion when *S* is expected due to the surface reflection of some of the *S* energy as *P* waves

The surface waves are well marked on the record. These begin with the wave tabulated as *L* by Macelwane in his table It has been clear for some time that this wave is not a Love wave since it has usually a vertical component. The recording of it on a device not sensitive to shear waves confirms this. The Love wave is regularly recognised on seismograms much earlier and is now frequently called *G*. It appears possible to recognise a later group of waves resembling the *M* waves on many seismograms Although not usually tabulated, there are three groups of seismic surface waves : *G* (Love waves), *L* and *M* Only the latter two were recognised on the well record.

The appended table gives the observed and computed times of the various groups of waves The maximum half amplitude on the record was 0 8 mm

Phase	Observed Time			Computed Time		
P	2h	10m	36s	2h	10m	37s
PR_1		11	16		11	10
PR_2			28			23
L		17	02		17 4	
M		20	21		19 8	

We wish to acknowledge the assistance given by Mr Theodore Netland

PERRY BYERLY.

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FRANCIS B BLANCHARD

East Bay Municipal Utility District,
Lodi

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[1] H T Stearns, Bull 18, Seis. Soc Amer , pp 9–15, March, 1928; S B Morris, paper read before a meeting of Seismological Society of America, Los Angeles, April 8, 1933 , A M Piper, *Trans Amer Geophys Union*, April, 1933 meeting, pp 471–475 , R M Leggette and G H Taylor, *Earthquake Notes*, 6, pp 16, 17, September, 1934

Sedimentation Equilibrium Measurements with Low Molecular Substances in the Ultra-Centrifuge

IN a recent paper[1] I have shown that it is possible to study the sedimentation equilibrium of the heavier inorganic salts (for example, CsCl, CsI, KIO_3, $LiIO_3$, $HgCl_2$ and others in 0·1 molar solutions) in the ultra-centrifuge of The Svedberg[2]. These experiments were carried out in a centrifugal field of about 200,000 times gravity By means of a refractometric method worked out by O Lamm[3] it was possible to study the change in concentration in the cell From the variation of the concentration set up by these intense centrifugal fields with the distance from the axis of rotation, the molecular weight of the substance may be calculated when the speed of the centrifuge and the temperature of the cell are known In addition, it is necessary to know the density of the solution and the partial specific volume and activity coefficient of the substance in solutions of like concentrations

The calculated molecular weights agreed fairly well with the known values for these substances except in the cases of the substance with the lowest molecular weight, CsCl, where the difference in concentration was very small

Quite recently, Prof Svedberg has greatly improved his ultra-centrifuge (see Svedberg, *loc cit*), and in October last a new rotor of a somewhat different construction from that already described in NATURE was tested at 155,000 r.p.m. and was ready for general work up to a speed of 140,000 r p m , corresponding to a centrifugal field of 710,000 times gravity in the middle of the cell. Although the cell for this rotor was not especially constructed for equilibrium experiments, it was decided to try to use it in this way with low molecular substances, at a speed of 120,000 r.p m., corresponding to a centrifugal field of 525,000 times gravity. At once it became clear that the difficulties in such high fields were very much larger, because the cell was deformed continuously. However, it was possible to diminish the influence of this deformation on the measurements by making alternate experiments with pure water (for the reference scale, for details see Pedersen, *loc. cit.*) and the salt solution In this manner we are able to relate values for a certain run to the run immediately before and immediately after it (each run took 6–8 hours)

By using this procedure there could be measured the change in concentration in the cell for such low molecular weight substances as NaCl, LiCl and the *simplest amino acid (glycocoll)* The molecular weights found were for NaCl 57 4 (58·454), for LiCl 37·8 (42·397) and for glycocoll 68 1 (75 05) The values in parenthesis give the true molecular weights. This result means that it is actually possible by means of the ultra-centrifuge to determine the molecular weight of all substances (soluble to a certain extent in water) from LiCl up to the huge hæmocyanine molecules (molecular weight 6,000,000)

The experimental difficulties connected with the gradual deformation of the cell we hope to be able to overcome by introducing certain alterations in its construction.

The calculations of these experiments were carried out in a somewhat different way from that used before[1], introducing the refractive index increment of the substance. Assuming that the same total amount of substance is present in solution in the cell when the equilibrium is established as at the start, it is possible by means of an integration method to determine the concentration of the substance at any point of the cell, and after this the molecular weight may be calculated either in the usual way or by introducing the value found for *dc*/*dx* in the differential formula for the molecular weight

Details will be published elsewhere

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Uppsala, Sweden.
Dec 22

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[1] Kai O Pedersen, *Z phys Chem*, A, **170**, 41, 1934

[2] The Svedberg, G Boestad and I -B Eriksson Quensel, NATURE, **134**, 98, 1934

[3] Ole Lamm, *Z. phys Chem*, A, **136**, 313, 1928 **143**, 177, 1929

Use of the Centrifuge in Determining the Density of Small Crystals

IN a previous letter[1] we described a method of determining the density of small crystals of a substance with the centrifuge for the purpose of determining its molecular weight. It has since been brought to our notice that essentially the same method has been used by S. B. Hendricks[2] though with a different object We should, therefore, like to correct the impression that we claim any novelty for this method of density-determination, while still wishing to point out its usefulness as a method of determining molecular weights to a high degree of accuracy

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D CROWFOOT

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[1] NATURE, **134**, 809; 1934

[2] *J. Opt Soc. Amer*, **23**, 299; 1933

Mechanism of Respiration

THE respiration of the minced breast muscle of the pigeon has been studied by means of specific poisons (malonic, maleic and arsenious acid) Experiments show that in the main process of respiration, no substances other than succinic acid and its first oxidation product, fumaric acid and the hydrate of the latter, malic acid, are oxidised directly by the Warburg-Keilin 'Atmungsferment-Cytochrom' system Both succinic and malic acids are activated by the corresponding specific dehydrogenase Only these two dehydrogenases seem to be connected immediately with the Warburg-Keilin system Succinic acid is oxidised by them to fumaric, malic to hydroxy-fumaric acid Both oxidations are reversible

Foodstuffs are oxidised by dismutating them with oxidation products of succinic acid, which products thereby become re-reduced and act thus as catalytic hydrogen carriers The 'oxidation system' is an enzyme complex acting specifically on succinic acid and its oxidation products Fermentation is an intramolecular dismutation Oxidation is dismutation with oxidised succinic acid

This research has been sponsored by the Josiah Macy, Jr, Foundation, New York

A SZENT GYORGYI

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Jan 26

Cosmical Chemistry

MANY will read with interest and admiration Prof H N Russell's fascinating and masterly address published as a supplement to NATURE of February 9; it is all that an address should be on such an occasion Having watched the story of ultramundane chemistry unfold from all but its Bunsen and Kirchoff-Stokes beginning, especially during the turbulent Lockyer period, I perhaps can appreciate both its beauty and the greatness of our advance in knowledge more than most, so may be allowed to tender to Prof Russell the thanks that so many, I am sure, will wish to express

What would the founder and first editor of NATURE have said to the use made of the spectroscope since he turned his instrument to the sun and discovered helium, the only element discovered in the sun, perhaps some day, when we draw pictures of atomic structure as we now do of molecular, to be recognised as the fundamental element as benzene is the fundamental carbohydride? The wave of enthusiasm then excited has rolled on with ever increasing amplitude and certainty of direction

The cosmos stands revealed before us, in wondrous simplicity too. Even organic chemistry is lifted up to the stars and shown to have the simplest possible beginning there in methane, together with ammonia Some planets, it seems, may be worlds of Franklin chemistry, with ammonia as snow

We are in face of a transcendent geology but whilst readers of NATURE may geologise on Mars and recognise ferric red on its surface rocks, few of our schools pay the least attention to mundane geology Dust has no ethics in most eyes our women wear it but without understanding Love of colour is a barbaric trait—understanding is not Are the masses ever to remain barbarians? What is to be the use of leisure in the future? At least, we should seek to civilise our politicians and all who strive to put themselves in authority over us · the freedom to display ignorance granted to these, as at Wavertree these last few weeks, is nothing short of a menace to society

Still, the physicians have to heal themselves When, fifty years ago, I began to teach my engineering students at the 'Central' to look chalk in the face, in the hope of leading them to take some slight interest in geology, I had the beautifully coloured large Geological Survey map of our islands, made by joining the separate sheets, pasted upon the wall, on the stairway leading to the laboratory, varnished and framed, it was there until I left in 1914 I made the class buy the key map of the Survey and Charles Kingsley's lectures on "Town Geology", advising students to hang the map up in their bedrooms Looking for the map at the jubilee celebration, at the 'Central', this week, I found the wall reduced to the condition of the map bought by the 'bravo Captain' in "The Hunting of the Snark"—a perfect and absolute blank ! Modern professors of engineering have no use for geology, their hearts are so encased in steel that they no longer see anything in stones A like map has reigned at the head of the stairway to the large science workshops at Christ's Hospital since the school was opened at Horsham more than thirty years ago I expect soon to see its place taken by School Certificates Geology is only brought before us to-day by the saving grace of the railway poster

HENRY E. ARMSTRONG.

Feb. 9

Wasting Disease of *Zostera marina*

IN Dr Kathleen B Blackburn's letter on this subject[1], the conclusion seems well established, through a study of the chromosomes, that the narrow-leaved form of the eelgrass (grass wrack), which has in many of the diseased areas replaced the larger and broader type of plant, is clearly a form of *Z. marina* and not a hybrid of *Z. marina* and *Z. nana*, as some have believed. Miss Blackburn therefore suggests that the difference in the width of the leaves of varieties of *Z marina* may be a purely ecological character. She further remarks that, in the localities examined, the width of the leaf of *Z marina* was directly proportional to the depth of the water, and that the very narrow-leaved forms were those that had been longest exposed by the fall of the tide, while the broader were those that had not been exposed at all

It may be of interest to report that on the American coast the evidence does not entirely support this ecological interpretation *Zostera marina* is the only species recognised as occurring on this side of the Atlantic, and it extends from southern Labrador (with outlying stations in southern Greenland and in James Bay) southward to a point near the city of Beaufort, North Carolina. In travelling from north to south, one notices a gradual and progressive reduction in the size of the plant and in the width of the leaf blade. Leaves from plants found in northern Maine, for example, are often more than three times the width of those from Pamlico Sound, North Carolina. The diameter of the rhizomes likewise undergoes reduction southward, and there is an accompanying reduction in the number of leaf veins.

Dr. Setchell, in his excellent paper, "Morphological and Phenological Notes on *Zostera marina* L."[2], does not specifically state that the plants in their first year of growth are smaller and have narrower leaves than in the more mature stages, although he seems to demonstrate this in his illustration of stages in the growth of plants From observation of *Z marina* in places where it has begun to re-establish itself along the Atlantic coast from Maine to North Carolina, there is ample evidence of this habit of growth In many such places the plant has shown some slight evidence of recovery, and wherever examined, the new growth has been found more slender than in the mature plants

At a point on the coast of eastern Maine where the average tide fluctuation is nearly 18 ft, I found eelgrass growing in more than 10 ft of water at mean low tide. The plants here were narrower than in those that appeared to be of the same age growing in shallower water It does not seem, therefore, that the depth at which the plant grows always is positively correlated with breadth of leaf

The observed characters of *Zostera marina* on the Atlantic coast of North America would seem to indicate that robustness is correlated with both temperature and age of the plant, the northern forms of a given age being larger and having broader leaves than those from farther south Perhaps the length of the growing season may be an important factor in this regard Setchell shows that vegetative growth of this species takes place when the water temperature is 10°–20° C, while reproduction occurs only between the temperatures of 15° and 20° C According to the same author, no growth or reproduction takes place when the temperature is either above or below these limits or during the period when the temperature is declining from 20° to 10° C, which he calls recrudescent rigor Thus, there is a shorter growing season in extreme southern latitudes than in most of the northern areas of the plant's normal range.

Among local factors that frequently influence the development of submerged aquatics may be mentioned water currents, temperature, the condition of the bottom, particularly in regard to type and texture of soil, and the chemical composition of the water, especially in relation to fluctuation of salinity of tide water sections of coastal river systems My own observations seem to show that the general vigour of *Zostera marina* is lessened in areas of greatly reduced salinity, and that at such places the leaf is comparatively narrow The above and other factors are to be considered in any interpretation of the causes of abnormal leaf development.

It is conceivable that, in some circumstances, as in British waters, the plants might be stimulated by depth to produce broad leaves, yet this does not seem to be typical of conditions on the American coast.

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Dec. 21.

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[1] NATURE, 134, 738, 1934
[2] *Univ Calif Publ Bot*, 14, No. 19, 389–452; 1929

Germination of Resting Spores of Onion Mildew (*Peronospora Schleideni*)

IN spite of the ubiquity of the Peronosporas and the frequent occurrence of sexually produced spores amongst the various species, very little is known in regard to the ultimate fate and method of germination of such oospores. Several workers have recently commented on this fact.

In a previous publication[1] attention was directed to the failure to germinate resting spores of *Peronospora Schleideni* in the laboratory, even when subjected to different treatments. The peculiar germination of one untreated spore, kept in a sealed moist chamber for several months, was mentioned in the same paper Since then, the germination of a number of resting spores of this fungus has been seen under more natural conditions

In the year 1930, I found a crop of onions in which enormous numbers of resting spores of onion mildew were being produced in the foliage. A sack-full of these leaves was collected and taken home, being then trampled into a large box provided with holes at the bottom for drainage Bacterial action soon commenced and the leaves went down into a vile-smelling mess, which after the lapse of a few weeks dried up, leaving a fine material a couple of inches deep in the box consisting of decayed leaf tissue and abundance of resting spores The box has remained fully exposed in a garden since then, and periodically, a little of the fine material has been removed in order to photograph any change occurring in the spores, and also to test for germination. The collapsed oogonium is remarkably persistent, and forms an additional protective layer 2–3μ in thickness around the thick spore wall.

Little or no change was seen in the spores until they were three years old, when it was found that in some cases the oogonium had disappeared wholly or in part, and the spore wall had thinned down to 2–1μ Germination of an odd spore was obtained at the end of four years, and after a further five months, on placing some of the material from the box in water in a warm room, approximately 1 per cent of the spores germinated after eleven days, a total of twenty-seven being observed Germination in all cases was by a stout germ-tube 6–9μ in diameter, which was capable of considerable growth in water, up to 960μ In a number of cases this germ tube branched Spores which were partly free from the oogonium and germinated were of a light straw colour, in some instances the germ-tube pushed its way out through the enveloping folds of the persistent oogonium. Whilst thinning of the spore wall has taken place in quite a considerable number of the spores, others show no visible change from those photographed at the end of the first year, and judging from their appearance they are probably good for another five years.

So far as I am aware, the above is the only record of the germination of resting spores of onion mildew

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Jan. 15.

ROBERT MCKAY.

[1] Murphy, Paul A, and McKay, Robert, *J Dept Lands and Agric Dublin*, **21**, 59–76, 1932

Crystallisation of Human Serum Albumin

APART from Oswald's report[1] that he had obtained globuliths from the albumin fraction of human ascitic fluid, we have been unable to find any account of the crystallisation of human serum albumin Recently we have succeeded in obtaining albumin crystals from two separate batches of pooled human sera

Serum was separated from the clot, heated for 25 minutes at 56° C. and fractionated within two or three days of bleeding. After addition of an equal volume of saturated ammonium sulphate and removal of the globulin, crystallisation was brought about by adding normal acetic acid The requisite amount was first determined for 5 c c portions, acid being added from a micro burette until the first faint permanent turbidity was observed, about 0 21 c c were required Whereas crystals of horse serum albumin usually appear within two hours of acidification under these conditions, we were unable to detect crystals in our preparations of human albumin before the following day Our experience has indicated that crystallisation of human albumin takes place within narrower limits of hydrogen ion concentration than is the case with horse serum albumin

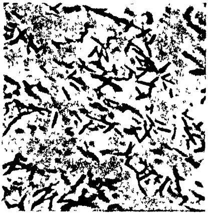

FIG 1 Crystals of human serum albumin ×540

The main bulk of the protein solution was treated by adding slowly the calculated amount of acetic acid After well defined crystals had formed, the yield was increased by addition of a further amount of acid—half the volume of that first used Two or three hours later a third addition of acid, equal to the second quantity, was made The following day the crystals were collected by filtration

The crystals obtained were readily visible under the 1/6 power of the microscope as small fine needles (Fig 1) As in the case of horse serum albumin, the crystals dissolved in water to give an opalescent solution which was clarified by filtration, the turbidity being apparently due to lipid associated with the protein

5 gm of crystalline albumin was obtained from 300 c c of serum, representing a yield of about 40 per cent of its albumin content Recrystallisation can be brought about by the method described by Adair and Robinson[2]

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Department of Pathology,
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Jan 8.

[1] *Z physiol Chem*, **95**, 102, 1915.
[2] *Biochem J*, **24**, 993, 1930

Stability of the Acetyl Radical

IT is usually supposed that free acyl radicals do not survive the shock of thermal or photo dissociation of the molecule from which they might be formed or, if formed, decompose further before they can react with other molecules to give rise to isolable products Thus Rice has shown that no diacetyl results from the thermal decomposition of acetaldehyde[1], and Norrish has concluded as a result of his studies of the decomposition of aldehydes and ketones that both of the bonds between the carbonyl group and the two groups attached to it are broken practically simultaneously, the two groups then, in general, uniting to form a saturated paraffin[1]

During an investigation of the photo-decomposition of di ethyl-peroxide, we have found that the chief products are ethyl alcohol and a greenish yellow substance which has been finally determined to be diacetyl Little if any acetaldehyde was produced, at any rate during the early stages of the decomposition The decomposition was very slow, and although no measurements of the quantum yield have been attempted, a chain reaction would seem improbable

The formation of ethyl alcohol and diacetyl can be accounted for by a mechanism based on that of Haber and Willstätter[3] for enzyme oxidations and also employed by Taylor and Gould to explain the oxidation of ethyl alcohol photo sensitised by hydrogen peroxide[4],

$$\mathrm{CH_3CH_2{-}O{-}O{-}CH_2CH_3} + h\nu \rightarrow \mathrm{2CH_3CH_2O{-}}$$

$$\mathrm{CH_3CH_2O{-}} + \mathrm{CH_3CH_2{-}O{-}O{-}CH_2CH_3} \rightarrow \mathrm{2C_2H_5OH} + \mathrm{CH_3\overset{|}{C}O}$$

$$\mathrm{2CH_3\overset{|}{C}O} \rightarrow \mathrm{(CH_3CO)_2}.$$

Such a mechanism necessitates a somewhat long-lived acetyl radical In order to obtain further evidence for this, we have examined the non-gaseous products of the decomposition of the three simplest ketones and acetaldehyde In all cases the products were of a greenish yellow colour, which was, however, only faint with diethyl-ketone and acetaldehyde

The products from acetone and methylethyl-ketone yielded with dinitro-phenylhydrazine a few milligrams of a substance almost insoluble in boiling alcohol (and therefore readily separable from the ketone derivative) but which could be recrystallised from pyridine. A derivative with similar solubilities was also obtained from the acetone product with mono-nitro-phenylhydrazine In all cases the physical properties of these derivatives agreed with those of the corresponding derivative of diacetyl. Damon and Daniels have also observed that the liquid products from the photo-decomposition of acetone are coloured

While far from being conclusive, this evidence would seem strongly to suggest that the acetyl radical is much more stable than is usually assumed, and that it possibly plays a significant rôle in the photo-decomposition of acetaldehyde and acetone at room temperature.

M. Barak,
D W G Style.

King's College,
Strand,
London, W C.2.

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[1] F O Rice, *Trans Far Soc*, 30, 168, 1934
[2] Kirkbride and Norrish, idem, 27, 407, 1931
[3] Haber and Willstätter, *Ber*, 64, 2844, 1931
[4] Taylor and Gould, *J. Phys Chem*, 37, 367, 1933
[5] Damon and Daniels, *J Am Chem Soc*, 55, 2370, 1933

Diffusion of Gases through Metals

I have read with interest the letter by Dr Smithells and Mr. Ransley on the diffusion of gases through metals in Nature of November 24 I agree with them that diffusion is dependent on the solubility of gases in metals, and that the approximate proportionality to $\sqrt{P}$ is related to the fact that sorbed hydrogen is not only monatomic, but also ionised, as pointed out by me[1] and by A. Coehn[2]. Further, adsorption on the surface must be distinct from absorption within the metal Absorption must be considered in the study of diffusion, just as Fourier and Poisson took account of specific heat in their classical equations for thermal conductivity

In occlusion and diffusion, the hydrogen is in the form of protons (or deutons). I think the condensation of molecules on the metal surface, due to electrostatic attraction, produces electronic perturbations in the surface metal atoms (as shown by the effect on the photo-electric properties), which facilitates the diffusion of the gas The effect of the adsorbed film can therefore only extend to a distance of one atomic diameter, and the mobility of protons within the metal will not depend on adsorption, but on the particular atomic arrangement of the metal and on the concentration gradient of absorbed hydrogen

An equilibrium exists between the adsorbed gas and the gas absorbed near the surface, in which the two concentrations have a fixed ratio for each gas-metal system. Diffusion therefore depends on many factors. The proportionality between diffusion and $\sqrt{P}$ can be readily interpreted theoretically The deviation from this law can be tentatively explained either by assuming an adsorption pressure threshold on one side and an evaporation pressure threshold on the other side of the metal; or alternatively, as suggested by Smithells and Ransley The hypothesis can be tested by considering the behaviour of palladium towards hydrogen and deuterium

From experiments which are still proceeding and will be published elsewhere, I have been able to show that palladium adsorbs deuterium very considerably from a mixture of hydrogen and deuterium, whereas it is well known that deuterium diffuses very slowly, in comparison with hydrogen, through palladium.

Tito Franzini.

Istituto di Fisica,
R Università,
Pavia
Dec 15

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[1] T Franzini, *Rend R Ist Lomb*, 709, 1931 *N Cim*, No 9, 1931
[2] A Coehn, *Z Phys*, 62, 1, 1930 71, 79, 1931 83, 291, 1933

Molecular Spectrum of Cadmium Vapour

In a recent article on the above subject, S. Winston Cram[1] has reported his inability to obtain, either in fluorescence or by excitation with a Tesla coil, a narrow diffuse cadmium band at 2212 He concludes that the band in that region which I obtained some years ago[2], using a pure electrodeless discharge in low pressure vapour, must be due to an impurity

During a year's leave of absence, when working in the astrophysics laboratory of the Imperial College of Science and Technology, I made a careful examination of the molecular spectrum of cadmium Although a full account of this work will be published later, in this letter I should like to direct attention to the following results relating to the origin of the band in question.

(1) As is shown by the spectra reproduced in Fig 1, an arc between cadmium electrodes emits a band at 2212 with an intensity greater than that of the emission band at 2125. This was first noticed in a few cadmium plates given me by H. G. Howell, of Armstrong College, Newcastle-on-Tyne. On trying

an arc myself, it was found that with exposures of the order of one or two seconds, the 2212 band appeared with marked intensity

(2) With a high-frequency (valve) circuit and external electrodes applied to a tube containing cadmium vapour at pressures ranging from 10 mm to 40 mm or higher, the narrow isolated band at 2212 was not obtained In agreement with Cram's results, it was found that the continuous emission on the short wave length side of the resonance line 2288 extended as far as a sharp edge in the neighbourhood of 2212 In two or three spectrograms, however, an increased intensity near 2212 gave the appearance of a narrow band at that place

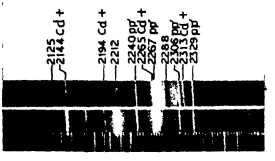

FIG 1 Arc spectra of cadmium with copper arc superimposed on the lower spectrum

(3) In the case of zinc vapour excited with the same high-frequency arrangement, an emission band at 2000 was obtained without difficulty at pressures of the order of 10–12 mm, as is clearly shown in Fig 2. This fact is not irrelevant to the origin of the 2212 cadmium band, because zinc and cadmium have corresponding absorption bands—at approximately 2064 and 2002 for zinc; 2212 and 2125 for cadmium In a note in the *Physical Review*, Winans[3] has stated that the 2212 cadmium and the 2064 zinc bands, both present in absorption, are both *absent* in emission

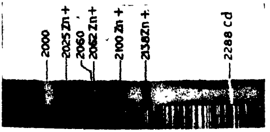

FIG 2 Spectrum of zinc vapour when excited by high-frequency discharge, with external electrodes. Copper arc superimposed

Although my observations as given in paragraph (2) might readily be used in support of Cram's view that the 2212 band is an impurity, it seems to me that the weight of the evidence is in favour of its being a true cadmium band In support of this position, I submit the following arguments.

(a) The undoubted presence of 2212 as an emission band in the arc makes it less probable that its appearance, under certain conditions, in an excited tube, is due to an impurity It is not without significance that in both the arc and the early electrodeless discharge showing this band, *pp'* lines are present with considerable intensity These do not occur in Cram's spectra (nor in my recent high frequency discharges), and it may be that the presence of a narrow band at 2212 is associated with the excitation of this group of lines

(*b*) The undoubted presence of a band in both emission and absorption, in the related element *zinc*, strongly suggests the probability that the corresponding band in cadmium should also be present in emission, as well as in absorption

(*c*) Since there is without question an absorption 2212 cadmium band, it is not a matter of surprise that there should be an emission band also Of course, this does not necessarily follow, but the presence of an absorption band does help to make it less likely that an emission band, found in the same place, is due to an impurity

The origin of certain diffuse bands which occur in the spectra of metallic vapours is, however, not always easy to settle It is only through the co-operation and continued experiment of different workers, using different conditions, that certainty can finally be reached

J K ROBERTSON

Queen's University,
Kingston, Canada
Dec 11

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[1] Cram, *Phys Rev*, **46**, 205, 1934
[2] Robertson *Phil Mag* **14** 795 1932
[3] Winans, *Phys Rev*, **37**, 902, 1931

Structure of Br III

THE spark spectrum of bromine, excited under different conditions, has been photographed over the wave length range λ450–7000, using various instruments, and lines belonging to the doubly ionised atom have been identified

These experiments have made possible the detection of the structure of Br III which is found in all its characteristic features to be analogous to that of Se II, classified recently by us[1] The intervals of the fundamental term $5s\ ^4P$ are 2587 and 2253 cm^{-1}, and those of $5p\ ^4D$ are 2413, 2070 and 658 units This scheme is however, at variance with the one published by Deb[2], which, we consider, is improbable in many important respects A complete report of the new classifications will be published shortly

K R RAO
S G KRISHNAMURTY

Andhra University,
Waltair, India
Jan 16

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[1] *Proc Roy Soc* (in press)
[2] *ibid*, A, **127**, 204, 1930

Large Sunspot Group of February 1935

ALTHOUGH the sunspot group referred to in NATURE of February 16 (p 260) was not specially large, it was of interest because of its very rapid growth Spectroheliograms in $K_{2,3,2}$ light were secured through thin cloud at the Solar Physics Observatory, Cambridge, on February 5, 6 and 7 On February 5 the group is shown on a plate exposed from 12^h 25^m 18^s to 12^h 26^m 51^s, and as the formation was near the centre of the disc, it must have been recorded very near 12^h 26^m 5^s As no spot was shown on the Greenwich photograph at 10h, this fixes the time of formation of the spot to within 2½ hours On the spectroheliogram the feature was very small On February 6 there is evidence of very rapid growth, preceding and following spots are clearly shown, and the group extended over about 10° of solar longitude February 7 still further expansion was shown, with an extent of flocculus of about 15° longitude Any other observations of this spot group on February 5 during the hours 10h to 12h 30m would be welcome as affording information of the details of development

C P. BUTLER.

Solar Physics Observatory,
University of Cambridge
Feb 16

Plasticity of Rock Salt Crystals

THE plasticity of rock salt crystals when immersed in water has been the subject of much attention recently[1] The fact that the effect takes place more easily in hot water suggests that the rate of solution of the surface is a factor I have therefore tried bending small plates of rock salt under running cold water from a large tap, and have found that the plasticity is surprising Under these conditions it is quite easy to make a right angle bend in a plate of rock salt more than a millimetre thick in a matter of seconds

E N DA C ANDRADE

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University College, London

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[1] See E G Joffe, "Physics of Crystals and *Proceedings International Congress of Physics, London*, 1934 (in the press)

Points from Foregoing Letters

HIGH-FREQUENCY radio waves such as are used in television (3–20 m in length), can increase the temperature of certain solutions and of living tissues, and have been used in medical practice (diathermic treatment) Dr Franz Nagelschmidt describes a method of directing and localising the heating effect by *interposing dielectric substances (wax, ebonite)* between the electrodes and object, and gives suggestions for practical applications

Automatic recorders of water-level in deep wells register earthquake shocks Prof Perry Byerly and Mr Francis B Blanchard describe a water-level recording instrument, and compare its record of an earthquake with that obtained by the usual type of seismograph They point out that both the primary tremors (*P*) due to compressional waves travelling through the earth's interior and the later undulations (*L*) due to compressional waves travelling along the earth's surface were recorded by the water instrument The intermediate vibrations (*S*) travelling through the earth's interior and the Love waves were not recorded This confirms the view that both these latter are shear waves and do not produce changes in volume, which alone affect the water-level.

By means of an improved Svedberg ultra centrifuge rotating 120,000 times per minute and giving a force of 525,000 times that of gravity, Dr Kai O Pedersen has succeeded in bringing about changes in the concentration of solutions of substances of low molecular weight From these concentration changes, deduced from the changes in optical refraction, the molecular weights have been calculated, they agree fairly well with the known values

Prof A. Szent-Györgyi in a succinct note states that in the main respiratory process of the muscle, the oxidisation of foodstuffs (or their loss of hydrogen) is brought about by oxidised products of succinic acid, these carry away the hydrogen in the presence of certain enzymes (dehydrogenases)

Mr Clarence Cottam agrees with Dr Kathleen Blackburn that the narrow-leaved form of the eel grass is not a hybrid but a different form of *Zostera marina*. From observations on the Atlantic coast from Maine to North Carolina, he concludes that the variation cannot be accounted for simply as due to the depth at which the plant grows, but that other factors such as the age of the plant, temperature, salinity, water currents and conditions of soil or rock bottom may affect the width of the leaves

The conditions under which the spores of the onion mildew germinate are insufficiently known Mr R McKay has kept the spores under observation for several years, and finds that at the end of three years about one per cent of the spores have their cell wall sufficiently thinned for them to germinate in water in a warm room, the others are still good for another five years' resting stage

Dr Muriel E Adair and Mr G L Taylor have succeeded in obtaining for the first time microscopic crystals of the albumin from human serum (from dropsical patients)

Mr M Barak and Dr D W G Style have obtained diacetyl and its derivatives by means of chemical reactions which suggest that the acetyl radical, CH_3CO- is much more stable than usually assumed They believe that this radical may possibly be an intermediate product in the photo-decomposition of acetaldehyde and acetone at room temperature, and in other important chemical reactions

Prof. Tito Franzini points out that the hydrogen atoms which penetrate metals have lost their electrons and consist of positively charged nuclei (protons) Dr Smithells and Mr Ransley have indicated that the deviation in the rate of hydrogen from the square root law ($D = K\sqrt{P}$) may be due to surface adsorption Experiments on the adsorption and rate of diffusion through palladium of ordinary and heavy hydrogen lead Prof Franzini to assume an adsorption threshold on one side and an evaporation pressure on the other side of the metal.

S W Cram, not being able to confirm the observations of Prof J K Robertson that cadmium vapour emits a band of ultra-violet light (wave-lengths around 2212 A), when excited by an electrodeless discharge, has suggested that Robertson's observations may have been due to an impurity Prof Robertson repeated the experiment and obtained only traces of the band in certain spectrograms He still believes, however, that cadmium emits such a band of light of wave-length 2212 A, and he submits spectrograms to show that it occurs in the arc spectrum of cadmium Cadmium vapour absorbs light of this wave-length and it is probable therefore that it also emits it.

Research Items

Dual Organisation in Assam. A study of social organisation in Assam by Mr J K Bose (*J Dept Letters, Calcutta University*, 25) is based in part on a review of existing literature, in part on the results of field-work in the period 1931–34 among the Anals, the Aimols, the Lamgangs, the Mantaks, the Marrings and the Memis It is thought that the dual organisation may throw light on the origin of the caste system Among the Aimols, a very primitive tribe, there are two moieties, one superior and the other inferior, each having two phratries and each phratry two patrilineal clans , but the system is in process of disintegration owing to decreasing numbers and the scattered situation of the villages Hence restriction in marriage is slackened , but in social and religious matters the dual organisation is strictly observed Thus the social status of the superior moiety is recognised in all the important offices in the villages The headman, assistant headman and priest all come from the superior moiety The two moieties are also apart in the festivals they observe The Anals, primitive hunter-agriculturists spread over sixteen villages in Manipur, have a typical dual organisation, while the Mantaks, a dwindling group, though in process of disintegration, retain a superior and an inferior moiety, but inferior officers are now drawn from the inferior moiety The Lamgangs, a remote hill-people, show two moieties with only four clans each Here there is evidence of the tendency to arrange the superior moiety in a hierarchy Among the Marrings the dual organisation is of unique type, being based on territorial distribution. The Marring villages are grouped into a set of seven and a second set of five This grouping has taken over the marital functions of the kinship groupings It is clear that in Assam there are definite forms of dual or tripartite organisation of various types and in various stages of disintegration. Assam is, therefore, likely to prove as interesting for the study of early stages of society as Australia or Melanesia

Reproduction in Nudibranchs. Mr Leslie A Chambers has made a valuable contribution to our knowledge of the methods of fertilisation and egg-laying in the Nudibranchiates (*Bull Amer Mus. Nat Hist* , 66, 1934). The forms of the genital ducts are divided into four main types, and taking *Embletonia fuscata* as a typical nudibranch, the author describes the anatomy and histology of its reproductive system There are three passages arising from the hermaphrodite duct—male, female and androgynous A three way valve effecting the selective separation of the spermatozoa from the ova is a feature hitherto undescribed, the author suggesting that it may have a possible general application to the hermaphrodite gastropods in which a separation occurs, that is to say, in most tectibranchs and all nudibranchs There is also a mechanism for erecting the penis which seems to be peculiar to *Embletonia* *Embletonia* was found in enormous numbers on the piles of a bridge near Beach Haven, N J , all the individuals depositing spawn In a few weeks they had all disappeared. This is typical of many nudibranchs, but as some species may be found breeding in the open sea as well as near the shore, it is suggested by the author that inshore spawning grounds are not essential, and that the large numbers of one species sometimes found spawning inland are due to the chance displacement and survival of a few individuals, and their rapid development, no migration taking place Anatomical evidence is given that each individual may pass through repeated reproductive cycles in the same season With so many broods and with every individual of each brood depositing numbers of spawn masses, each single mass containing several hundred ova, there is considerable possibility of deriving the presumed migrations from a single individual cast on the shore by chance

***Calanus* Production in Norway** Mr Jacob D Somme has thoroughly investigated the biology of two species of *Calanus* (*finmarchicus* and *hyperboreus*) based on experimental studies and analyses of samples from the coast of Norway in various seasons (*Fiskeridirektoratets Skrifter Serie Havundersokelser*, **4**, 9 , 1934) Both species winter in the Lofoten area at great depths *C hyperboreus* particularly is restricted in winter to the inner parts which are very deep, *C finmarchicus* being not so sharply defined in its distribution In spring a vertical migration takes place, and later both species are carried away over the coastal banks in the surface currents The spawning area of *C hyperboreus* is very restricted and mainly dependent upon the extent of the winter area of distribution, the development of the later stages probably depending on low temperatures *C finmarchicus* has a much longer period of spawning and a much larger spawning area Both species may be found together Tables for the identification of all stages are given, and it is shown that the larvæ of the two species are not distinguishable by morphological characters, but by *measurement of the carapace* rather than total length Unfortunately, the paper by Dr S G Gibbons on *Calanus finmarchicus* (Fisheries, Scotland, Sci invest , 1933 No 1) was published too late for it to be used, as was also Dr Nicholls's study of the life history of *Euchaeta* (*Proc Roy Soc. Edinburgh*, 1934)

'Plaster Mould' Diseases of Mushroom Beds A very useful article by Mr W M Ware appears in the *Gardeners' Chronicle* of December 22 and 29, 1934 It describes two 'weed' fungi which are likely to grow on mushroom beds, to the detriment of the edible fungi Both of the undesirable organisms are known as 'plaster moulds', since they produce a white, powdery covering similar to a dusting of plaster or lime The white plaster mould (*Oospora fimicola* - *Monilia fimicola*) was known by English growers some time before it was recorded by the mycologist It also occurs in France and the United States Characters of the species are given in detail, and its occurrence described It appears on beds just before they are ready for spawning, and also grows upon the covering of soil or 'casing', which is applied after the spawn has been added Circumstantial evidence indicates that the fungus is introduced by the manure. The brown plaster mould (*Papulaspora byssina* or *Myriococcum praecox*) originally made its appearance in the United States in 1923, but has now appeared in Great Britain This disease appears at the same time, and under similar conditions to the white plaster mould, but is not usually so harmful.

It first produces a white superficial mycelium, which quickly becomes cinnamon brown except at the edges The brown part bears 'bulbils', or aggregations of hyphal cells, which seem to function as the sole reproductive bodies of the fungus The brown plaster mould also seems to be introduced by the manure

Traps of the Bladderworts It is refreshing to find a genus of plants, the bladderworts (*Utricularia*), which scores so admirably off the animal kingdom Prof F E Lloyd (*Biol Rev*, **10**, 1, 72, 1935) gives an extremely interesting account of the various kinds of traps—really modified leaves—and especially of the entrance mechanisms The swiftness of the action is remarkable By making use of motion photomicrography speeded up to 160 frames per second, the whole action falls within the sequence of five frames, the opening phase falling between two frames and the slower closing phase occupying the rest of the time The entrance mechanisms of the traps are shown to be far more complicated and more delicate in their adjustments than has heretofore been thought, and are shown to be purely mechanical in action.

Clean-up of Gases by Getters. The process of removal of gas by the action of electropositive metals such as magnesium and barium is of great technical interest since it is much used in the evacuation of vacuum devices A L Reimann (*Phil Mag*, Dec 1934) has investigated the process for the 'getters' magnesium, calcium and barium and a number of common gases Some clean up occurs when the 'getter' is first volatilised on to the walls of the vacuum vessel (dispersal gettering), there is then some absorption of gas by contact action and the rate of removal is accelerated by maintaining an electric discharge in the gas The 'dispersal gettering' may be treated as 'contact gettering' by a series of freshly formed getter surfaces The contact gettering is more effective with barium than with magnesium or calcium, and is greatest when a black deposit of finely divided barium was formed by dispersal in the presence of gas In most cases of contact gettering, the getter can take up much more gas than would cover its surface with a monomolecular layer –the gas seems to diffuse into the interior of the deposit The gettering is *usually favoured by a rise in temperature* The gas absorbed by a getter may be liberated again by *heating, by displacement by another gas, or by* impinging electrons or ions In one of the experiments on a valve, if the anode potential was applied before the filament was heated, the getter acquired a positive potential and the vacuum deteriorated by electron bombardment of the getter If the filament was heated and anode potential then gradually increased, the floating getter deposit acquired a different, lower, stable potential and the vacuum began to improve by clean-up In electric discharge gettering, the getter removes particles such as positive ions and metastable molecules, and in some cases these form chemical compounds which are more stable than the products of simple contact gettering.

Oxygen Isotopes in Meteorites. An investigation on the relative abundance of the oxygen isotopes O^{16} and O^{18} in stony meteorites (S H Manian, H C Urey and W Bleakney, *J Amer. Chem Soc*, **56**, 2601; 1934) by a method involving the conversion of the combined oxygen to water and then, by electrolysis, to oxygen gas, showed that the specific gravity of the water indicated, within an experimental error of 29 per cent, in the ratio O^{18} O^{16}, the same isotopic composition of the oxygen from three stony meteorites (Mocs, Knyahinya, Homestead) as from terrestrial granite and from potassium chlorate Relative abundances of the isotopes in the oxygen gases were investigated by the vacuum mass spectrograph and the same results were found, the experimental error in O^{18} O^{16} being reduced to ± 2 5 per cent The value 514 ± 13 1 is submitted for the absolute abundance ratio O^{16} O^{18} for both terrestrial and meteoric oxygen The agreement of this result with other mass-spectrographic determinations is compared, and the discrepancy with the band spectra value is pointed out The average value of the mass-spectrographic determinations by the four different researches (omitting the results of Kallmann and Lasareff) is 517 ± 10

The Methylene Radical By the thermal decomposition of diazomethane carried in a current of ether or butane below 500°, the free methylene radical, $.CH_2$, appears It removes mirrors of tellurium, selenium, antimony and arsenic from the tube In the case of tellurium, a red solid polymer of telluroformaldehyde, $(HCHTe)_n$ is produced, whereas free methyl forms a volatile red liquid, dimethyl ditelluride, $CH_3TeTeCH_3$ F O Rice and A L Glasebrook, who report these results (*J Amer. Chem Soc*, **56**, 2381, 1934), point out that they are not in agreement with current ideas on the nature of the methylene radical, most of which are based on Nef's premise that carbon compounds readily undergo a primary decomposition into a stable smaller molecule and a radical containing bivalent carbon, and some lines of evidence which would indicate that methylene should have a peculiar stability resembling that of a molecule rather than that of a free radical At temperatures above 650°, it was found, but below the decomposition point of ether, only methyl groups were found, the methylene radical is apparently a highly reactive fragment of short life

Meridian Observations of Faint Stars in Selected Areas. In the *Annalen van de Sterrewacht te Leiden*, **25**, 4, Dr C H Hins publishes a general catalogue of positions and proper motions of 1190 standard stars in areas 2–115 of Kapteyn's plan of selected areas This work is the reduction to a uniform system, and combination, of the work of five observatories taking part in Kapteyn's plan, namely, Leyden, Berlin Babelsberg, Bonn, Paris and Strasbourg. The positions are in every case modern meridian circle observations of right ascension and declination, and proper motions have been found by comparison with old observations · but it is found that the modern precision so much exceeds the old that better proper motions would be obtained by repeating the observations in a few years time than by combining new with old observations. The author has reduced all the observations to the Leyden system as fundamental (This system is in full agreement in R.A, and in very close agreement in Dec, with the P G.C system) The magnitudes of the stars lie for the most part between $7{\cdot}6^m$ and $9{\cdot}8^m$, the average magnitude being $8{\cdot}5^m$ The unit of weights is, on the average, $\pm\, 0{\cdot}0275^s \sec \delta$ and $\pm\, 0{\cdot}44''$ for R.A and Dec respectively, the weights attached to individual stars being for the most part from 2 to 10 Dr. Hins may be very heartily congratulated on the completion of this part of Kapteyn's plan of selected areas.

Effect of the Earth's Magnetic Field on Cosmic Rays in the Stratosphere

By MAX COSYNS, Physical Laboratory of the "Fondation Medicale Reine Elisabeth", Brussels

DURING the last ascent of the balloon *F N R S* (August 18, 1934), we had the opportunity of measuring with precision the intensity of cosmic rays at altitudes of about 12,000 m, 15,000 m and 16,000 m, by means of the ionisation chamber (Kolhörster type) which was used during our previous ascent with Prof A Piccard (August 18, 1932)

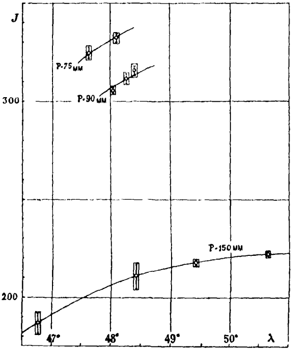

FIG 1

The comparison of these data, and also those of the previous ascent, shows clearly an effect of the earth's magnetic field

From our sixty values of ionisation intensity (J), obtained at pressures of the atmosphere (P) ranging from 73 mm to 170 mm of mercury, and between 46° and 51° of north magnetic latitude (λ), we can deduce functions relating J to P, and J to λ (Figs 1 and 2)

In Fig 1, the circles give the mean values, the vertical lines give the probable error calculated from the dispersion of individual observations, the rectangles give the total probable error, calculated from the dispersion of individual readings, and from the precision of measurements of atmospheric pressure and geographical position The atmospheric pressure was measured by means of two mercury barometers, the geographical position was determined by vertical photography with a Leica camera and infra red films (precision = 30″) or by astronomical observations *when the clouds below were too thick for* photography (precision = 10′) The geomagnetic latitude was calculated taking 78° 30′ N and 69° 8′ W. as the co-ordinates of the pole of the principal earth-magnetic doublet[1]

Through the four points of Fig 1 which correspond to a pressure of 150 mm., we can draw a smooth curve; if we multiply the ordinates of that curve by reduction coefficients obtained from Fig 2 (J vs P), for pressures of 90 mm and 75 mm, we obtain the two upper curves of Fig 1, fitting the corresponding points within the probable error

A comparison of these results with the theoretical curves of Lemaître and Vallarta[2] shows perfect agreement if we assume that more than 80 per cent of the ionisation in the stratosphere (for $\lambda > 50°$) *is due to a charged corpuscular radiation of magnetic* hardness $X_0 = 0 \cdot 30 \pm 0 \cdot 02$, and to the secondaries emitted by that radiation in the earth's atmosphere Within the limit of experimental error, this is in perfect accordance with the results of Clay[3], who found $J = 12$ at $P = 150$ mm, and $\lambda = 48°$, and those of Clay and Compton[4], showing a maximum curvature of the (J vs λ) curves for about $\lambda = 50°$, at pressures between 450 mm and 760 mm

The analysis of our (J vs P) curve (at $\lambda = 48°$) (Fig 2) by means of the Gross Lenz method[5], gives a transformed curve $P\Psi_p = PJ_p - P^2 dJ_p/dP$, showing three maxima, corresponding to about 130 mm, 190 mm and 400 mm of mercury Although their position is not defined with precision, the existence of the maxima seems to be beyond doubt, the amplitude of the corresponding variation of J being more than three times larger than the probable error

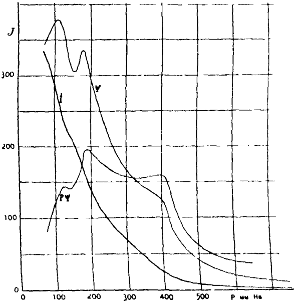

FIG 2

These three maxima show the existence of, at least, three soft components in the cosmic radiation, with ranges of the order of 130 mm, 190 mm and 400 mm of mercury But, as the shape of the (J vs λ) curve requires a very narrow range of magnetic hardness *for the primary rays, only one of these components, if any, is a primary one*

To my idea, the hypothesis according best with the observed facts would admit a primary radiation consisting of two corpuscular components *A* and *B*, of respective magnetic hardness $X_{0A} = 0 \cdot 30$ and $X_{0B} = 0 \cdot 45$. The *A* component, positively charged, would give secondaries (electrons and positrons) of discrete energy distribution, of which the hardest three components would have absorption coefficients of the order of 0·0018, 0·0039 and 0·0057 $\text{gm}^{-1}\ \text{cm}^{2}$. The *B* component would give secondary radiations of the same nature as the secondaries issuing from *A*, with an energy distribution as yet unknown, but corresponding to an absorption coefficient of the order of 0·0027 $\text{gm}^{-1}\ \text{cm}^{2}$.

The *A* and *B* components may perhaps be identified with Regener's components H_1 and H_2, their respective magnetic hardness X_0, calculated by the method proposed by Heisenberg[6], gives the right order of magnitude, if we assume that the primary rays are α particles. If we suppose that X_{0A} is exactly equal to 0·30, we find $X_{0B} = 0·50$, this gives a good reproduction of Clay's curves (*J* vs. λ) at sea-level. However, Regener's values for the respective intensity of those components at the earth's surface are not in good agreement with our hypothesis. But it must be noted that the calculation of those intensities requires many assumptions about the secondary emission mechanism, it might be, therefore, that a new discussion of deep water measurements, with different assumptions, would give values more in accordance with magnetic effects.

Our hypothesis is also in quantitative agreement with the east-west asymmetry observed by H. Johnson and others. Quantitative divergences from those measurements may be attributed to the fact that we know little about the angular distribution of secondaries around the primary direction, and also to the fact that no account has been taken of the atmospheric electrical field effect. This effect is not negligible for the softer part of the radiation responsible for east-west asymmetry, as a calculation of a lower limit of the variation of the angle of incidence β of rays gives $\Delta\tan\beta = \pm 515\, E^{-1/2}$ (where *E* is the energy of the ray, in electron-volts).

A more detailed account of the experiments described above will be published soon. The measurements were made possible by the help of the Belgian "Fonds National de la Recherche Scientifique", with the advice of Prof. A. Piccard and with the very efficient help of N. Van der Elst.

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National Water Policy in Great Britain

THE recently issued report of the Joint Conference of the Institution of Water Engineers, the British Waterworks Association and the Water Companies Association on national water policy is a document of considerable interest, dealing, as it does, with a matter of vital public importance which has been debated for some time past in the Press, in Parliament and in various other quarters. It is to be regretted, however, that the Committee to which the question has been referred, appears to have been composed of representatives or consultants of water supply undertakings (mainly municipal) for domestic purposes, and, so far as can be gathered from a scrutiny of the names of the members, there was no direct representation of the commercial and industrial users of water, as also of other interests no less vitally concerned in the exploitation of the country's supplies. Land drainage and the prevention of floods, although necessarily bound up in any national water policy, evidently did not come within the purview of the Committee. Neither has any consideration been given to the aspects of the matter as affecting fisheries, navigation, canal sources of supply, and the like. The report is concerned solely with the allocation of water supplies to domestic uses.

The first matter dealt with is the proposed establishment of a 'water grid', put forward some time ago by Mr. Alan Chorlton, M.P., and advocated by him in a presidential address to the Institution of Mechanical Engineers in October 1933. This scheme, which is based on the analogy of the electricity grid, is condemned in the report in no uncertain terms. "We are definitely of opinion," states the Committee, "that as regards water supply, such a system is totally unjustifiable from every point of view, and especially in its economic aspect." The proposal is analysed in detail in a memorandum attached as an appendix to the report, summarising the objections under eight heads, which, for reasons of space, cannot be discussed here. Although, perhaps, controversial in some respects, they are weighty in substance and the cumulative effect is decidedly condemnatory. The Committee expresses itself as quite satisfied with the *status quo*. "In the unusual difficulties resulting from the recent exceptional drought, the water undertakers of this country have generally proved themselves well qualified to protect the true interests of their consumers and to meet their obligations to the public at large." Accordingly, the Committee is equally averse to the nationalisation of water supplies under a National Water Board. It considers the Ministry of Health to be the proper central water authority, and puts forward a proposal to meet the conditions at present prevailing by the "creation of a distinct, separate and specialised Water Department of the Ministry of Health", with various powers which are set out in detail.

It is perhaps not surprising that a Committee, constituted as stated above, should affirm its faith in the Ministry of Health as the sole suitable arbiter and dispenser of water throughout the country, but for the reasons already given, this can only be considered as a one-sided view. Other interests will scarcely be disposed to agree to such a monopoly. The British Association Research Committee on Inland Water Survey, whose investigations are referred to non-committedly, has been urging the establishment of a national survey of water supplies on a purely scientific basis under the Department of Scientific and Industrial Research. The Government, while acceding to the overwhelming demand for a survey, has seen fit to disregard this recommendation and to place the survey in the hands of the Ministry of Health. It is difficult to appreciate the grounds upon which this step has been taken, since no analogous example from the practice of other countries have been cited in support of it. That the Ministry of Health, the proper functions of which are clearly indicated in its designation, should intervene in other spheres where its action and control might be misguided and detrimental, is a matter greatly to be deprecated.

BRYSSON CUNNINGHAM.

The Process of Coagulation in Smoke*

IN contradistinction to hydrosols, smokes are unstable systems. Their particles cohere when brought together by Brownian agitation, and this process of coagulation proceeds spontaneously until the system becomes a coarse suspension of complex aggregates, and finally sediments rapidly.

In recent years, special methods have been developed for counting the number of particles in many types of smoke, and the process of coagulation has been studied quantitatively in a variety of systems. It has been found experimentally that the decrease with time of the number of particles in a smoke is given to a first approximation by the expression $1/n - 1/n_0 = Kt$, where n is the number of particles present in a given volume at time t, n_0 the initial number and K a constant. As is well known, an expression of the same form is valid for the recombination of ions, but in a normal smoke the combination of particles to form aggregates is only influenced slightly, if at all, by electrical charges.

A comparison of the coagulation constants or K values for different smokes of about the same mass concentration shows that they vary between comparatively narrow limits from about 0.8×10^{-9} cm.^{3} sec.$^{-1}$ in the case of oxide smokes formed in the electric arc to 0.50×10^{-9} cm.^{3} sec.$^{-1}$ for a standard smoke of stearic acid of mass concentration of 15 mgm. per cubic metre.

The structure of the aggregates and the nature of the material do not, so far as is known at present, exert any marked effect on the rate of coagulation, which appears to be a purely physical process dependent on the chance encounter of particles in Brownian motion. Experimental evidence, however, shows that the coagulation constant increases rapidly when the average size of particle falls below 1×10^{-5} cm. radius, and it increases also with the degree of heterogeneity of the smoke. By a careful study of the conditions under which a smoke is formed, Patterson and Cawood have prepared disperse systems of stearic acid particles which initially approach to uniformity in size. This was accomplished by dispersing the heated solid in a rapid blast of hot air, and by this means diluting rapidly the concentrated smoke before coagulation had proceeded far. Such smokes are readily reproducible and form standard systems which coagulate at the same rate and contain the same number of particles, and since they form compact aggregates they approximate in character to ideal systems of spherical particles.

The well-known theory of von Smoluchowski, which has been confirmed experimentally for the coagulation of sols by the comprehensive researches of Tuorila, when modified so as to apply to aerial systems, enables the coagulation constant of a homogeneous smoke to be calculated from first principles. Patterson and Cawood have shown that when the experimental data for these 'blown smokes' are interpreted rightly, a remarkably close agreement between theory and experiment is obtained. Theory also indicates that whilst in sols undergoing quick coagulation the rate should be independent of size, in aerial systems it should increase as the particle size diminishes; a prediction in entire conformity with experiment.

Both in sols and aerosols, theory shows that heterogeneity must increase the chances of encounter between particles, but although in sols it has been possible to check experimentally the extension of von Smoluchowski's theory proposed by H. Muller, for heterogeneous smokes theory so far has not proved more than a qualitative guide.

The study then of smokes affords strong confirmatory evidence of the validity of Smoluchowski's theory, and lends support to the view that this continuous process so characteristic of these systems is akin to the quick coagulation of sols in the presence of electrolytes, and points to the probability that in both classes of system every collision between particles is effective. It must, however, be noted that the coagulation constants for systems of fine suspensions in water and in air are widely different, the latter being about a hundred times as great as the former. But since the time taken to reduce the original number of particles in a system to any given fraction depends on the number as well as on K, the disappearance of particles by coagulation in town fogs and other polluted atmospheres will be slow.

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* Substance of the Liversidge Lecture delivered by Prof. R. Whytlaw-Gray, O.B.E., F.R.S., before the Chemical Society on February 14.

British Industries Fair, 1935

IN the account given last year in NATURE of the 1934 British Industries Fair, it was described as the largest national trade fair in the world. The 1935 Fair, which opened in London on February 18, is even larger than its immediate predecessor—a reflection, it may be hoped, of increasing prosperity in the nation's trade. At Olympia the lighter industries occupy every available square foot of exhibiting space, while the textile and furnishing sections at the White City are larger and more fully representative than ever. The main object of the Fair is, of course, a commercial one; the most welcome visitors are buyers. But the Fair has, undoubtedly, an educational value, for it presents to the visitor, in an attractive and accessible form and in a condensed space, a general survey of the results of the nation's manufacturing industry. Moreover, every changing phase in the tastes and habits of the people is reflected in such a collection of manufactured articles as is to be found at the Fair. The removal of much that is tedious and unnecessary from domestic work is indicated by the increased popularity of chromium-plated ware and of stainless steel and stainless silver articles, and by the space allotted in the Fair to the exhibition of devices for domestic mechanisation. The exhibition in larger quantities of open-air equipment of all kinds indicates that increasingly the leisure of the people is being used in healthy pursuits.

At Olympia, the exhibition is, as previously, divided into sections according to industries, and it is perhaps symbolic of the increasing recognition of the co-operation which must exist between science and industry, that the section devoted to the exhibition of the products of the Scientific and Optical

Instruments Group should occupy a prominent position near the main entrance to the Fair. The exhibits of the various firms in this section are placed so compactly together that a visual impression is conveyed of the co-operation and joint effort which is to be found among the members of the industry. The instruments shown are mostly optical in character, and one is reminded again of the large part played in scientific and industrial life by the products of the optical firms. Besides the normal instruments for laboratory equipment, special instruments are shown for use in aeronautics, astronomy and meteorology, together with those specially adapted to nautical and surveying requirements. One is impressed by the success which has been attained in so many of the instruments in combining the robustness required for industrial use with the necessary delicacy of movement.

Few things have been more striking of recent years than the development of long-distance telegraphy. It is but a short time ago that the first photographs were telegraphed from Australia to England, and quite recently a cinematograph film was exhibited in England showing events which had taken place but a few hours earlier in Australia. The exhibit of Cable and Wireless Ltd. is, on this account, of special interest. The modern system of long distance telegraphy is admirably shown at its stand. The types of apparatus used for this work are presented in actual operation, and a study of the receiving and transmission units, magnifying relays, distortion removers and regenerators gives the visitor a clear idea of the inventive research which has enabled long-distance telegraphy to become part of his daily life. Realism is added to the demonstration by the fact that a written telegram, handed in at one end of the stand, is delivered as an automatically typed message at the other end after having passed through the complete system.

The chemical industry provides another example of the co-operation which may exist between firms in the same industry to their mutual benefit. Messrs. Hopkin and Williams and British Drug Houses Ltd. have combined their knowledge and experience to further the production of chemical reagents of an exceptionally high standard of purity, and these reagents are being exhibited by the firms. The very large field covered by the activities of Imperial Chemical Industries Ltd. is well illustrated by the fact that this firm has thought it worth while to devote a large portion of its space at the Fair, not to the display of its products, but to a presentation of its sales machinery. By means of interesting maps, the way in which chemical products enter into almost every phase of industry throughout Great Britain is clearly demonstrated. The same firm is making a special point of the hydrocyanic acid method of fumigation, especially for the cleansing of vermin-infested houses. Great success is claimed for this method of fumigation, and specimens of the fumigant and of its prospective victims are shown. The same fumigant has a variety of other and more pleasant uses, the removal of fruit-damaging insect pests from orange groves being specially emphasised as being of interest to overseas visitors.

Of the other industries represented at the Fair at Olympia, no section is more attractive, and certainly none more colourful, than that of the glass and pottery trades. A more perfect blending of utility and beauty can scarcely be imagined. It is perhaps fitting that the products of possibly the most ancient craft represented at the Fair should appear so near to perfection. The beauty of the exhibits is enhanced by the excellent lighting, and the stands furnish an example of the use of modern lighting effects to improve the display of goods. Quite near to the glass and pottery section, on the floor above, is a large area devoted to plastics, and it is not uninteresting to compare the products of this very modern industry with those of the very ancient one mentioned above. The increasing use which is being made of plastic materials is reflected in the very large increase of space occupied by the plastic group. In this industry the gap between laboratory experiment and workshop practice has been most effectively and rapidly bridged.

The fact that in London alone more than fifteen hundred firms are exhibiting almost every variety of manufactured articles makes it obviously impossible in a limited space adequately to describe such a Fair. In addition to these firms, one hundred and thirty four inventors are displaying for the first time to the purchasing public the results of their ingenuity, which range from rubber contrivances for the prevention of housemaid's knee to a mechanical device for 'breaking-in' new pipes.

At the White City every phase of textile manufacture is represented; whilst the furniture section at the same place presents a wide field of interest to those concerned with the evolution and modern developments of furniture. The Fair remains open until March 1. The Engineering and Hardware Section opens in Birmingham on May 20.

University and Educational Intelligence

CAMBRIDGE.—At the Congregation of the Regent House a grace will be submitted appointing Prof. G. H. F. Nuttall, Magdalene College, emeritus professor of biology, Prof. E. D. Adrian, Trinity College, Prof. R. C. Punnett, Gonville and Caius College, Balfour professor of genetics, and Mr. C. Forster Cooper, Trinity Hall, University reader in vertebrate zoology, delegates from the University to the tercentenary of the National Museum of Natural History in Paris next June.

At Newnham College the Henry Sidgwick Memorial Lecture will be delivered on March 9 in the College Hall at 5 p.m. by Sir John Russell, director of the Rothamsted Experimental Station. The subject of the lecture is "The Impact of Science on the National Life".

THE thirteenth Unity History School will be held in Rome on April 15–22. The subject of the meeting will be "Science in the Modern World". On April 15, the inaugural lecture entitled "Science and Philosophy" will be delivered by Prof. F. Enriques, president of the School of the History of Science, University of Rome. Other lectures will be delivered by Mr. F. S. Marvin, director of the Unity History Schools, Prof. H. Dingle, Dr. W. A. Parr, Prof. E. Radl, Dr. C. H. Desch, Prof. C. Formichi, Dr. G. Sarton, and M. Lheritier. Several discussions have also been arranged. Further information can be obtained from Mrs. K. E. Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

VOCATIONAL guidance service finds a valuable auxiliary in the *Journal of Careers* (monthly, 1s.). The December issue contains "The Prospect in

Surgery" by Sir Holburt Waring, a sequel to an article in the preceding month by Sir Humphry Rolleston on general medical practice and the main branches of specialisation. Sir Holburt gives expression to a view which, he says, will be considered in many quarters as revolutionary, namely, that the methods which are beginning to be practised in industry—selection on account of special aptitude, mentality and physical characteristics, might well be applied in surgery and also in the various branches of medicine. *Considerable space is devoted to civil* aviation in addition to the first of a series of articles on the opportunities of new careers which the development of flying will offer, there is a summary of an address by Prof Sutton Pippard to the Royal Aeronautical Society on the training of an aeronautical engineer Veterinary surgery as a profession for women is discussed by Beatrice Lock, this being the second of a series of articles on "Women in the Professions" Another useful series deals with the prospect for public school and secondary schoolboys in the iron and steel industry, the article in the December issue being on technical and commercial posts. Lieut -Col Levey, managing director of the West African Information Bureau, writes on the prospects for British commerce in West Africa The *Journal* has not failed to direct attention to the complaint, voiced in the presidential address to the Association of Special Libraries and Information Bureaux by Sir Richard Gregory, of the inadequacy of the arrangements made for the treatment of scientific news in daily and weekly newspapers New fields of work should be opened up for science graduates with journalistic ability.

Science News a Century Ago

Telford and the Institution of Civil Engineers

At a special meeting of the council of the Institution of Civil Engineers held on February 23, 1835, the following extract from the will of Telford was read. "To the president for the time being of the Civil Engineer Institution in trust, the interest to be expended in annual premiums under the direction of the Council, 2,000£ "

"All my scientific books, book cases, prints and such drawings, as my executors shall consider suitable, are to be delivered to the Civil Engineer Institution for its use and benefit, on condition, that all those articles, as well as the books, prints and drawings, shall, in case of the said Institution being discontinued, be delivered to the Royal Society, Edinburgh, for its use."

The council resolved that the premiums should be both of an honorary and pecuniary nature, and that the honorary premiums should consist of gold, silver and bronze medals, and that in the distribution of premiums no distinction should be made between natives and foreigners.

The Zoological Society

On February 24, 1835, Owen read a paper to the Zoological Society entitled "Description of a Microscopic *Entozoon* infesting the Muscles of the Human Body". He said that upwards of fifteen different kinds of internal parasites were already known to infest the human body, but none had been found of so minute a size, or existing in such astonishing numbers, as the species he described The musc of bodies dissected at St Bartholomew's Hospit had been more than once noticed by Mr Wormal the demonstrator of anatomy, to be beset wit minute white specks, and this appearance havi again been remarked in the body of an Italian, ag *forty-five years*, by Mr *Paget*, a student at t hospital, who suspected it to be produced by minu Entozoa, the suspicion was found to be correct, a Owen had been furnished with portions of t *muscles for examination* An account of his observ tions was published in the *Philosophical Magaz* of June 1835

University of London

The annual general meeting of the proprietors the University of London was held on February 2 1835 The report expressed satisfaction at the pro pects of the institution, and stated that the numb of students in the Faculty of the Arts and La during the year had increased from 122 to 137, t number of students in Medicine from 347 to 37 The number of pupils in the junior school h increased from 284 to 303 The total receipts f 1833 had been £9,890 *3s 0d* and for 1834 £9,9 *16s 8d*

The Natural History of Wasps

A paper on the natural history of wasps was re on February 27, 1835, by the Rev E T Bigge, Merton College, to the Ashmolean Society of Oxfor The object of the paper, said the author, was correct the mistakes into which several writers ha fallen, and to state the results of his own observatio on two species, *Vespa vulgaris* and *Vespa Britannic* The former, he said, was common in all parts of t kingdom, the latter, though occasionally met wit in the southern counties of England, was abundant the northern districts, and in Scotland, as well as the northern parts of Europe Having directe attention to the points of difference in the two specie the author went on to state some interesting fac relating to both species Societies of wasps, as bees, consist of three different classes of inhabitant males, females and neuters The neuters, or im perfectly developed females, are the common was which infest our houses and gardens, and form th majority of the colony The author had never se a nest of either species in which he had not observe after 9 o'clock, in the summer months, a sentin watching the entrance to the nest A ground ne has two apertures, one for entry and one for exi It is curious that if one stops up a wasps' nest, th returning wasps will not sting the aggressor, whil those which escape from the inside will attack hi instantly

Weather in the United States

In the *Mechanics' Magazine* of February 28, 183 it was stated that: "The winter in America ha been one of almost unprecedented severity. January the thermometer sunk at New York t *5° below zero—at Baltimore to 10°—at Washingto* to 16°—at Albany to 32°—at Montreal to 35° an at New Lebanon in Columbia county to below 40 the mercury in the bulb being 'congealed and fo some time immovable'. The harbours of Portland Newburyport, Boston, New Bedford, New Haven Philadelphia and Baltimore have all been froze over; some of them hard enough to bear carriages

Societies and Academies

London

Royal Society, February 14 G. Barry, J W Cook, G A D Haslewood, C L Hewett, I Hieger and E L Kennaway The production of cancer by pure hydrocarbons (3) Tests for cancer-producing activity on the skin of mice have been carried out with a number of pure compounds of known molecular structure, most of which have been polycyclic aromatic hydrocarbons In all, some 140 different compounds have now been tested Of these, 69 are related to 1 2-benzanthracene and 25 of them have given positive results 1 2-benzanthracene itself has very little carcinogenic activity, but such activity is shown by derivatives in which substituents (saturated alkyl groups or additional rings) are attached to positions 5 or 6, or both The most active so far encountered is methylcholanthrene, a hydrocarbon which was obtained by simple chemical means from the deoxycholic acid of bile In this way a direct relationship has been established between the carcinogenic compounds and some normal constituents of the body Of 71 compounds not related to 1 2 benzanthracene, 65 have given completely negative results Of the 6 compounds which gave positive results, only 3 4-benzphenanthrene ahd considerable activity The remaining 5 compounds gave only 10 tumours (2 epitheliomas and 8 papillomas) in 360 mice By way of contrast the 25 carcinogenic compounds *related* to 1 2-benzanthracene gave 437 tumours (335 epitheliomas and 102 papillomas) in 1,220 mice C H Waddington, J Needham, W W Nowinski and R Lemberg Studies on the nature of the amphibian organisation centre (1) Chemical properties of the evocator An evocator, that is, a substance capable of causing the ectoderm of the amphibian gastrula (*Triton* spp, axolotl) to differentiate into neural tissue, has been obtained in ether extracts of whole newt bodies and of mammalian liver The active substance is present in the unsaponifiable fraction, and in the part of that fraction precipitable with digitonin It comes out with the cholesterol if the unsaponifiable fraction is allowed to crystallise from alcohol in the cold, and is probably of a sterol-like nature An active ether soluble substance, which is also precipitable with digitonin, has been isolated from crude preparations of glycogen The whole of the evocating activity of glycogen may be due to the admixture of this substance C H Waddington and D M Needham Studies on the nature of the amphibian organisation centre (2) Induction by synthetic sterol-like substances Certain synthetic hydrocarbons have been implanted into young amphibian gastrulæ Inductions of neural tissue have been performed by 1 9-dimethylphenanthrene, 9 . 10-dihydroxy-9 10-di *n*-butyl-9 : 10-dihydro 1 . 2 . 5 : 6-dibenzanthracene, and 1 . 2 5 . 6-dibenzanthracene The first two of these are œstrogenic and the third carcinogenic. There is therefore probably a group of evocating substances which overlaps with the group of œstrogenic and carcinogenic substances This provides the first satisfactory evidence that more than one substance is capable of evocating, and suggests that the naturally occurring evocator is a sterol like substance

Edinburgh

Royal Society, February 4 W L Bragg The new crystallography (Bruce-Preller Lecture) The mapping of atomic arrangement by X-ray analysis first applied only to crystalline solids but more recently extended to glasses, liquids and gases, has now been pursued for more than twenty years A review of the influence which this new knowledge has had in many branches of science is impressive Some idea of this influence can be gained by taking examples in inorganic chemistry, organic chemistry, mineralogy, metallurgy and biochemistry Though such isolated examples are only random soundings over a wide area, they serve to give an impression of the precision, simplicity and novelty of outlook which a knowledge of the actual atomic arrangement introduces They also indicate the fascinating lines of research which are opening out ahead

Paris

Academy of Sciences, January 7 (*C R*, **200**, 101–176) Emile Borel An elementary demonstration of formulæ on the distribution of prime numbers V Romanovsky A formula of A R Crathorne relating to moments Alexandre Weinstein The stability of plates with fixed edges Pierre Massé A partial differential equation of the theory of intumescence Gérard Petiau The wave equation in a relative movement Nicolas Kryloff and Nicolas Bogoliuboff Study of the case of resonance in problems of non-linear mechanics Léon Capdecomme The use of a buffer accumulator for stabilising the current supply of an incandescent filament The accumulator is placed in parallel with the filament on the main circuit · its automatic regulation is shown to be at least as good as any other automatic regulators in use and has the advantage of simplicity Néda Marinesco An ultra micrometer with stabilised valve Constantin Salceanu and Dumitru Gheorghiu The magnetic susceptibility of organic liquids Applications to the law of additivity Using an improved method of measuring, giving an accuracy of the order of 1 per cent, the authors cannot confirm divergencies found by other workers from the additivity law Mario Reggiani · The influence of electrolytes on the formation and stability of the metallic colloids obtained by ultra sonic waves In the preparation of colloidal mercury by means of ultra-sonic waves, the velocity of formation, the stability and diameter of the particles are all susceptible to a very slight chemical modification of the dispersing phase The effect of traces of albuminoids (less than 0·1 per cent) is very marked in this respect Jean Cournot and Georges Meker · The cementation of copper by aluminium André Girard and Georges Chaudron The constitution of rust Experiments on the cause *of production of the magnetic oxide* of iron by metallic iron in the presence of rust Henri Guérin The reduction of the arsenates of the alkaline earths by carbon Barium arsenate A detailed study of the products given by a mixture of barium arsenate and carbon heated in a vacuum at temperatures between 500° C. and 1,200° C Pierre Dubois and Edouard Rencker . The dilatometric study of the dehydration and thermal decomposition of some manganese compounds. André Morette The reduction of the vanadium oxides by carbon monoxide and by carbon Xavier Thiesse · The preparation and properties of sodium ferrate (hypoferrite). A solution of ferrous sulphate dropped into a boiling concentrated caustic soda solution gives a green solution of hypoferrite containing up to 20 gm. of $Fe(OH)_2$ per litre. The solid salt is precipitated on cooling. The alkaline solution does not appear to be oxidised by air. Jean Amiel The preparation and properties of some cupritetrachlorides and cupritetrabromides Joseph Biechler Researches on the dicyanimides Sodium amide and cyanogen bromide react, under conditions specified, giving a good yield of sodium dicyanimide Marcel Mathieu. The structure of the dinitrocelluloses Results of an X-ray study Marcel Roubault. The origin of the crystalline schists of Kabylie de Collo (Department of Constantine, Algeria) Mlle J Roess: Study of the elasticity of rocks by the method of restitution The application of photography to the falling ball method of measuring elasticity. Boris Choubert · The ancient strata of Gabon. France Ehrmann and Jacques Flandrin: Concerning the large Lepidocyclines of the Eocene of *Beni-Afeur (south of Tahor, Departement of* Constantine) Paul Fallot and Gonzague Dubar The presence of Lias containing Rhynchonellina in the Spanish Rif Albert F de Lapparent The nummulitic transgression in the Provence Alps Daniel Schneegans The discovery of strata with *Cardita Beaumonti* at Gabon (French Equatorial Africa) Jacques de Lapparent The structure of the mountains and the tectonic position of the bauxites on the slopes of Parnassus (Greece) Adolphe Lepape The origin of the helium of natural gases The relation between *the richness in helium and of* lithium in certain saline hydro-mineral springs Em de Martonne and Mme Fayol A formula for the aridity index Joseph Blayac and Mlle Marie Chaubet Palæontological discovery in the Llandeilo sub-stage of the Ordovician of the Montagne-Noire Pierre Dopter and Mlle Thérèse Frémont The absorption of nitric nitrogen and of ammoniacal nitrogen by the higher plants Mladen Paic and Marcel Philippe A pigment elaborated by the diphtheria bacillus Some pigment is absorbed from the culture broth by collodion, but the toxicity of the culture is not reduced Alexandre Besredka and Ludwig Gross The importance of the point of inoculation in the evolution of the Ehrlich sarcoma

LENINGRAD

Academy of Sciences (*C.R*, 4, No 3) A Svetlov and V Stroganov. Solution of a magnetic problem in two dimensions A Arsenjeva: Photo electric transmission in crystals of silver chloride. G Krutkov Linear problems of the theory of Brownian movement (3) A Levashov: A contribution to the theory of gravitation. V. Fesenkov and E Piaskovskaja: Brightness of the day-time sky and the scattering of *light in the atmosphere* A Balandin, J Eidus and N. Zalogin: Formation of butadeine and acetylene from ethylene by the high-frequency discharge V Sadikov and V Menshikova. Action of the animal proteolytic enzymes on the vegetable proteins The proteins in seeds are not affected by pepsin and pancreatin G Levitsky New fixing solutions revealing the morphology of chromosomes. E. Hasratian · Physiology of irradiation and concentration of processes in the cortex of the cerebral hemispheres I Vasiljev: Vernalisation of winter varieties and frost resistance. The process of vernalisation lowers the frost resistance of winter varieties. V Karasik and M. Lichatchov: Relation between the chemical nature and the biological activity of the dihydroxide of methylphenarsazine and of its derivatives G Flerov. Some geographical and historical variations in the Eurasian Ungulates J Schaxel Determination of the regeneration of extremities in axolotl (1) O Zviaginzev A new mineral containing metals of the platinum group B Licharev The problem of the age of the Safet-Daron chalk in Darvas

(*C R*, 4, No 4) I. Vinogradov Some theorems of the analytical theory of numbers N Koshljakov A general summation formula and its applications L. Keldysh Measurable functions B A Alexandrov · Quantum conditions and the Schrodinger equation I Kurchatov Artificial radioactivity and Landé's scheme N Zelinskij, B Michailov and G Arbuzov Thermal dissociation of the carbohydrates of the cyclohexane series J Ryss and R Urickaja *Dissociation of magnesium chromate* V Sadikov, V Rozanova and G Novoselova Autoclave splitting of blood albumin by means of a 2 per cent potassium carbonate solution G Levitskij Fixation changes of the chromosome body. S Krajevoy *Trisomics and heterochromosomes in Scorzonera nervosa*, Trevir N Shapiro and R Serebrovskaja Relative mutability of the *X*- and the second chromosomes of *Drosophila melanogaster* The mutation frequencies of the *X*- and the second chromosomes are proportional to the lengths of the genetically active parts of these chromosomes R Berg Relative mutation frequencies on *Drosophila* chromosomes O Tchernova A new, widely distributed genus of may-flies from the northern regions of the U S S R J Schaxel Determination of regeneration in the extremities of axolotl (2) Transplantation of regeneration stages

VIENNA

Academy of Sciences, December 6 Herbert Haberlandt and Karl Przibram A labile coloration of fluorite A number of specimens of greenish or bluish fluorite develop, either in the natural state or after irradiation with radium, a violet colour when exposed *to ultra-violet light at the temperature* of liquid air This coloration, which soon fades when the mineral resumes the ordinary temperature, is probably related to the excitation of Lenard's short-lived centres. Richard Grossmann Measurement of strong polonium preparations by ionisation in pure nitrogen By ionisation of nitrogen of such high purity that the negative carriers are free electrons, the activity of polonium preparations showing ionisation currents up to 42,000 electrostatic units may be measured Karl Strubecker Lie's representations of the line elements of the plane on points of space Arthur Wagner Critical remarks on the daily course of cosmic ultra radiation from records taken on the Hafelekar (2,300 m). Observations made from September 1931 until December 1933 are analysed and discussed, various sources of error being indicated Rudolf Wagner Methodical specification of pentameric pre-floration

December 13 Elisabeth Matzner Atomic disintegration by neutrons. The elements carbon, aluminium, sulphur, iron, cobalt, nickel, copper, zinc, gallium, molybdenum, silver, cadmium, tin, platinum and lead have been investigated, as regards atom disintegration by beryllium neutrons excited by polonium, by two different methods, which give concordant results The greatest effects were found with carbon and nickel, and the smallest with lead and tin. **HERBERT HABERLANDT** Investigations on the luminescence of fluorites and other minerals. Various new fluorites showing a natural red radio-photofluorescence are recorded, two of them showing the presence of radioactive inclusions In certain fluorites with a yellowish-white photofluorescence, the active impurities are bituminous in character **JOSEF SCHINTLMEISTER** and **GEORG STETTER** Investigation of the disintegration of the light elements with the double-tube electrometer. All the light elements as far as chlorine have been examined The fall in the disintegration is approximately exponential from the maximum for nitrogen, with a periodic function superimposed, the values for the odd elements being always greater than those for the even ones **A SKRABAL** Reaction cycles Reaction cycles are based on a reaction scheme which may be decomposed into two or more separate schemes with the same total reaction These reactions occur far more frequently in chemical kinetics than is generally supposed, and include all reactions which proceed along two or more paths **OTTO AMPFERER** Tectonic studies in the Rhine valley.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, February 24

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30.—M A Phillips "Fossil Mammals" *

Monday, February 25

BRITISH MUSEUM (NATURAL HISTORY), at 11 30—G. Seccombe Hett. "Bats" *

ROYAL GEOGRAPHICAL SOCIETY, at 5 30—Sir Norman Watson "In the Coast Range of British Columbia". (Film)

ROYAL SOCIETY OF ARTS, at 8—D R. Wilson "Factory Accidents". (Shaw Lecture Succeeding lectures on March 4 and 11.)

Tuesday, February 26

UNIVERSITY COLLEGE, LONDON, at 5 30—Prof J R Mathews: "The Northern Element in the British Flora" (succeeding lectures on February 27 and 28) *

ROYAL SOCIETY OF ARTS, at 4 30—L A Jordan "Empire Production of Tung Oil"

Wednesday, February 27

UNIVERSITY COLLEGE, LONDON, at 5 30—I C Gröndahl: "Norwegian Students' Life in the Nineteenth Century" (succeeding lecture on March 6) *

Thursday, February 28

BEDFORD COLLEGE FOR WOMEN, at 5.15—Dr. R A. Sampson "Astronomical Time".*

THE CHEMICAL SOCIETY, at 8—(at the Royal Institution, Albemarle Street, W 1)—Dr. A S. Russell. The Madame Curie Memorial Lecture *

Friday, March 1

GEOLOGISTS' ASSOCIATION, at 7 30—(at University College, Gower Street, W C 1)—Annual General Meeting Sir Albert E Kitson "Outlines of the Geology of the Gold Coast, British West Africa"

ROYAL INSTITUTION, at 9—A Bryant "Samuel Pepys: known and unknown"

Official Publications Received

GREAT BRITAIN AND IRELAND

The Institute of British Geographers Publications Nos 1 and 2 Transactions, and The Pastoral Industries of New Zealand, by R Ogilvie Buchanan Pp xv+99 (London George Philip and Son, Ltd, Liverpool Philip, Son and Nephew, Ltd) 7*s* 6*d*

The Registrar-General's Statistical Review of England and Wale for the Year 1933 (New Annual Series, No 13) Tables, Part 2 Civil Pp iv+130 (London H M Stationery Office) 2*s* net

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1608 (A 160) Abstract—Constitution of Magnesium Rich Alloys of Magnesium and Nickel By J L Haughton and R J M Payne Pp 2 (London H M Stationery Office) 2*d* net

The University of London Animal Welfare Society Eighth Annual Report, 1st July 1933 to 30th September 1934 Pp 16 (London)

Scientific Horticulture (formerly the H E A Year Book) Vol 3, 1935 Pp 228+xliv (Wye Horticultural Education Association) 3*s* 6*d* net

The Carnegie Trust for the Universities of Scotland Thirty-third Annual Report (for the Year 1933-34) submitted by the Executive Committee to the Trustees on 6th February 1935 Pp iv+82 (Edinburgh)

Congrès International des Sciences anthropologiques et ethnologiques Compte rendu de la première Session, Londres 1934 Pp xxxii+340 (London Royal Anthropological Institute) 25*s*

British Chemicals and their Manufacturers the Official Directory of the Association of British Chemical Manufacturers (Incorporated) Pp 459 (London Association of British Chemical Manufacturers) Gratis

London School of Hygiene and Tropical Medicine Classified Catalogue of Books in the Library, including Departmental Libraries Part 2 Classes C and D, Theory and Practice of Medicine and History of Medicine Pp ii+31-51 (London) Gratis

OTHER COUNTRIES

Cornell University Agricultural Experiment Station Bulletin 610 A Study of Practices in Feeding Infants, Results of a Survey of 657 Babies in Villages of New York State, 1930 By Rachael Sanders Bizal Pp 34 Bulletin 613 An Economic Study of Land Utilization in Montgomery County, 1932 By F F Hill and George T Blanch Pp 50 Bulletin 614 Rural Social and Economic Areas in Central New York Pp 100 Bulletin 615 Clothing Purchased by Farm Families in Tompkins County, New York, 1927-28 By Beulah Blackmore Pp 44 Bulletin 616 Study of Artificial Incubation of Game Birds, 1 Temperature Requirements for Pheasant and Quail Eggs 2 Humidity Requirements for Pheasant and Quail Eggs By Alexis L Romanoff Pp 39 Memoir 169 A Physiological Study of Dormancy in Tilia Seed By J Nelson Spaeth Pp 78+4 plates (Ithaca, N Y)

Smithsonian Miscellaneous Collections Vol 91, No 17 Reports on the Collections obtained by the First Johnson-Smithsonian Deep Sea Expedition to the Puerto Rican Deep—New Sponges from the Puerto Rican Deep By M W de Laubenfels (Publication 3288) Pp 28 Vol 93, No 1 The Effect of Ultraviolet Radiation on the Ova of the Ascarid Roundworms *Toxocara canis* and *Toxascaris leonina* By W H Wright and E D McAllister (Publication 3291) Pp 13 (Washington, D C Smithsonian Institution)

Colony and Protectorate of Nigeria Annual Report on the Geological Survey Department for the Year 1933 Pp ii+52+8 plates (Lagos C M S Bookshop, London Crown Agents for the Colonies) 4*s* net

University of Michigan School of Forestry and Conservation Bulletin No 5 The Hungarian Partridge in the Great Lakes Region By Ralph E Yeatter Pp 92 (Ann Arbor University of Michigan Press) 35 cents

Palæontologia Sinica Series C, Vol 8, Fascicle 1 On the Carnivora from Locality 1 of Choukoutien By Pei Wen-Chung Pp 222+24 plates Series C, Vol 8, Fascicle 3 On the Insectivora, Chiroptera, Rodentia and Primates other than Sinanthropus from Locality 1 at Choukoutien By Chung Chien Young Pp 166+10 plates Series C, Vol 10, Fascicle 1 On the Fossil Pisces, Amphibia and Reptilia from Choukoutien, Localities 1 and 3 By M N Bien Pp 36+8 plates (Peiping Geological Survey of China, The French Bookstore, London Edward Goldston, Ltd)

Trinidad and Tobago Report on an Investigation into the Uses and Marketing of Forest Products in Trinidad and Tobago (Council Paper No 100 of 1934) Pp 85 2*s* 6*d* Forestry Pamphlet No 1 What Forestry in Trinidad Means Pp 12+2 plates 6*d* Forestry Pamphlet No 2 The Forest Types of Trinidad and their Principal Species Pp 16+2 plates 6*d* (Trinidad Government Printing Office)

Union of South Africa Department of Agriculture Science Bulletin No 137 (Division of Chemistry, Series No 134) Influence of Fertilizers on the Nitrogen and Carbon Cycles in Soils, Experiments carried out on the Red Loam of the Zebediela Area, Northern Transvaal By Dr P Kamerman and H Klintworth Pp 26 (Pretoria Government Printer) 3*d*.

Biological Movie Booklets. Vol 1 Normal Cell Division. By Clyde E Keeler Pp 46 Vol. 2 Maturation of Sperm By Clyde E Keeler Pp 94 Vol 6 Fertilization By Clyde E Keeler Pp 65 (Washington, D C American Genetic Association) 3 vols, 1 50 dollars

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Problems of Human Nutrition

OF the two factors which together mould the individual, heredity and environment, modern knowledge is attributing more and more importance to the latter ; in fact, as Sir Frederick Gowland Hopkins pointed out in his Sir Henry Trueman Wood Memorial Lecture delivered before the Royal Society of Arts on February 6, although inheritance must set definite limits to the possibilities before each individual, environmental influences can decide whether, within those limits, the highest level possible is reached, or only a level which may be much lower than this. Among all the demands which the body makes on its environment, that for its food is of outstanding importance, and it is to-day becoming recognised that right nutrition, especially in early life, may profoundly affect the well-being and social value of the individual Knowledge obtained by scientific inquiry is beginning to take the place of instinct and appetite aided by very slowly growing transmitted experience There is still to be combatted the idea that the race, having survived through the ages without such knowledge, can continue to thrive without making any practical use of it but mere survival of a race is no proof that the majority of its members have ever lived in optimal conditions, or have ever displayed to the full their innate capacities

Briefly, the essential constituents of a diet are proteins of good biological value, fats, carbohydrates, minerals and vitamins The energy value should be not less than 3,000 calories *per diem* for the average man –probably it would be better to take the higher figure of 3,400 calories as suggested by the Committee of the British Medical Association The value of a protein depends on how far its constituent amino-acids resemble those of the body in nature and grouping, so that animal proteins are of higher biological value than vegetable Although fats and carbohydrates are interchangeable as sources of energy, yet both are necessary in the diet. Fats cannot be properly utilised in the absence of carbohydrates, and it is now known that certain fatty acids are as essential constituents of a diet as some of the amino-acids The relationship of the mineral elements and the vitamins to different diseases is now well known. To sum up, scientific research during the last two decades has shown that nearly forty individual substances must be present in a food supply to make it completely adequate

It is not always realised how easily a diet, generally considered satisfactory, can be improved, or how easily experimental alterations in a food supply, carried out without complete knowledge of what constitutes a proper diet, may spell disaster Corry Mann investigated the effect of adding 1¾ oz of butter or one pint of milk daily to the ordinary diet of boys in an institution The average weight and height increases for the three groups, on diet alone, diet plus butter and diet plus milk, were, in one year, 3·85 lb and 1 84 in , 6·3 lb and 2 22 in , and 7 lb. and 2·63 in , respectively Again, Christ's Hospital School, by utilising the results of the modern science of nutrition, has been able, during the past twenty years, to increase the height and weight of the boys until they are now several inches taller and several pounds heavier than boys of similar age who have not had the benefit of a sound diet During the War, when food was short and of poor quality, and substitutes had to be used, the Christ's Hospital records show that liability to bone injuries and fractures rose rapidly and did not diminish until 1922 (*Planning*, No 44, Feb 12, 1935) On the other hand, a short time ago, the island of Nauru in the Pacific suffered from a most alarming outbreak of beriberi, especially infantile beriberi the officials in charge of the island had first of all encouraged the consumption of milled cereals, and then forbidden the consumption of the intoxicating national drink—'toddy'—made from fermented sweet swathe of the coco-nut Thus the diet was deficient in vitamin B_1 It is dangerous for authority, with inadequate knowledge of problems of nutrition, to control food policy.

What then is a proper diet ? Much of the teaching of modern research may be summed up in statements so simple that elaborate scientific efforts may, to some minds, seem to have been superfluous. To convey the essentials of to-day's scientific teaching, it is only necessary to insist that fresh green vegetables and fruits are not luxuries but necessities, and that cereal foodstuffs, and especially cereals artificially fractionated, must not so dominate a diet as to exclude an adequate supply of fresh animal products—if not of flesh, then of the products of the dairy In this connexion it may be pointed out that a review of the voluminous literature indicates that pasteurisation of milk, when properly carried out —an important reservation—affects its nutritional value to no more than a negligible degree. Nevertheless, it is a sound policy to encourage the practice of giving extra sources of vitamins A, C and D

Why is the application of these discoveries only slowly taking place ? The issue of *Planning* referred to above points out that, apart from the inherent difficulty of changing ingrained habits of thought and living, there is no general agreement on standards of nutrition and so on what constitutes malnutrition There is an urgent need for a trustworthy standard, based upon objective tests capable of universal and uniform application, so as to yield comparable results in different places and periods

Education of the public in the facts of nutrition as disclosed by modern research is an essential Properly presented, public taste will respond to our increasing knowledge of the factors necessary to make a diet completely adequate , in fact, it has already responded to a remarkable degree, considering the number of obstacles—confusion, inertia, lack of co-ordination and vested interests of all sorts—which stand in the way. Thus, compared with the average of 1924–27, our 1932 *per capita* consumption of margarine fell by 20 8 per cent and of flour by 2 per cent (bread remaining unchanged), while consumption of fruit rose by 8 2 per cent, of milk by 15 5 per cent, of eggs by 32 7 per cent and of butter by 40 3 per cent These changes are not parallel to changes in price . consumption of bread has not increased in spite of the fall in price, and the consumption of milk and eggs has increased considerably faster than prices have fallen

At the same time, it must be emphasised that our knowledge is far from complete. We do not know the optimum intake of calories for children of different ages, or the optimum supply of the individual vitamins We do not know what beneficial modifications of a dietary may be desirable at special periods of life, as at puberty, for example, or in the case of a pregnant woman. These are merely instances of knowledge yet to come. There can be no doubt, however, that a general and intelligent application of existing knowledge would lead to betterment in the health of the nation ; large and delicate readjustments are called for, which will intimately affect social habits and will touch directly or indirectly the development of many industries and branches of distribution.

Reviews

The Carotenoids

Carotinoide: ein biochemischer Bericht uber pflanzenliche und tierische Polyenfarbstoffe Von Prof. Dr. L Zechmeister. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 31) Pp xii+338. (Berlin Julius Springer, 1934.) 29.40 gold marks

IN the last decade, perhaps the most rapid progress in any field of organic chemistry has been in that of the natural colouring matters. The anthocyanins have been mastered by Robinson and the porphyrins and chlorophyll by Hans Fischer; but it is the carotenoid pigments which have provided the most sensational progress, mainly in the hands of Karrer and of Kuhn.

Carotene was discovered by Wackenroder in the root of the carrot in 1831, and lycopene in the tomato by Millardet in 1876, though it did not receive this name until 1903, from Schunck Before the beginning of this century the carotenoids were chiefly studied by botanists and physiologists, and though their results were of considerable biological interest, little information on the chemical properties of these substances was obtained. Then Willstätter, at the same time as his researches on chlorophyll, investigated the yellow pigments of the leaf, developing methods for their isolation and purification and establishing for the first time their correct formulæ.

It was a tragedy that Willstätter's work was interrupted by the outbreak of the War, and his skilled collaborators dispersed to their respective countries to take up arms against one another. The work on chlorophyll and the carotenoids was never resumed owing to the cost of the material and of the large amounts of organic solvents necessary. Willstätter had established the empirical formulæ of the chief carotenoids; lycopene and carotene were shown to be isomeric hydrocarbons with forty carbon atoms, and leaf xanthophyll to be a dihydroxy carotene He had also guessed correctly the type of compounds they are, in suggesting for them, as for phytol, the alcoholic component of chlorophyll, the isoprene building stone found in the terpenes and rubber.

So the problem of their structure lay until 1927, when Prof. Zechmeister showed by catalytic hydrogenation that carotene and xanthophyll contained eleven ethylenic linkages and must be bicyclic, while lycopene contained thirteen ethylenic linkages and was an unsaturated aliphatic molecule At the same time, Kuhn and Winterstein had synthesised the important series of diphenyl polyenes, the colour of which depended on a chain of conjugated double bonds. Theoretical qualms about the possibility of a purely aliphatic hydrocarbon being so intensely coloured were at once dispelled, and it became clear to several chemists that the carotenoids owed their colour also to a chain of conjugated double bonds Kuhn and Winterstein applied these ideas to the carotenoid bixin from annatto, while Karrer simultaneously applied them to crocetin from saffron The carotenoids, being built up of isoprene units, are polyene pigments with methyl side chains, or 'polyprenes'

It had long been observed that a smell of violets is produced when carotene autoxidises, and Karrer and Helfenstein brilliantly seized on this clue and proved the odour was due to β-ionone Ionone rings were shown to be the cyclic structures present in carotene, and on the basis of oxidation experiments the correct formulæ for carotene and lycopene were suggested exactly one hundred years after the publication of the discovery of carotene

A feature of these formulæ is their symmetry about the middle of the molecule, one half being the mirror image of the other this was originally suggested by analogy with the triterpene squalene occurring in fish livers, which was synthesised by Karrer and Helfenstein after they had reinterpreted the structural evidence provided by Heilbron, but is now proved absolutely by direct experimental evidence, due chiefly to Kuhn.

This symmetrical structure of the C_{40} carotenoids has suggested to many a relation to phytol, which was synthesised by F G Fischer in 1929, two molecules of which joining together form the essential skeleton of the carotenoids The evidence from plant physiological sources on the relation between the carotenoids and chlorophyll is contradictory, and remains to be satisfactorily interpreted. Phytol is always found in chlorophyll and is never known to be replaced by any other alcohol On the other hand, carotenoids develop in bacteria which contain no chlorophyll It is to be hoped this problem will be attacked again.

Investigation of plants has brought to light three isomeric carotenes and a series of hydroxy carotenes or xanthophylls with one, two, three, four or six hydroxyl groups, the last is the fucoxanthin of brown algæ, and it is likely that new carotenoids remain to be discovered in the algæ In the petals of a flowering plant as many as five different carotenoid pigments may exist together, and it is obvious that they are formed one from the other, though so far this has not been imitated in the laboratory. A particularly interesting but little understood relationship is that of carotene to lycopene; it has been shown, for example, that tomatoes ripened above 30° C. do not produce lycopene.

Besides the C_{40} carotenoids of general distribution, there exist in plants rarer carotenoids with a smaller carbon skeleton, the ascertained structure of which proves without doubt that they are derived by oxidative cleavage of the C_{40} carotenoids. In saffron, not only is the pigment crocin known, but also Kuhn and Winterstein were able to isolate the other fragment of the original carotene molecule as the glucosidic bitter principle picro-crocin, an extremely elegant demonstration of the course of biosynthesis.

The identification by von Euler and Karrer of carotene as provitamin A, being converted and accumulated in the animal as the almost colourless vitamin A, is a familiar story which need not be repeated here. It is the most important result of the study of the carotenoids. To chemists the interest is the limitation of the activity to carotenoids in which the β-ionone ring is unsubstituted and its failure in derivatives like the xanthophylls, the physiological importance of which is not yet established. A fascinating problem is the source of vitamin A in fish livers, and the discovery of the point in the complicated food cycle on which fish depend at which carotenoid is transformed into vitamin.

To-day the nation is beginning to demand quality in its milk and butter supplies; it is found that the carotene content of butter runs parallel to its vitamin A content, thus serving as an indicator of quality. Winter butter contains much less vitamin than summer butter, and so the practice of artificially colouring butter to appeal to the consumer's eye conceals its poor quality. The irony of the practice is evident when it is realised that the substances annatto and saffron used for artificial colouring are themselves carotenoid pigments, but neither of them possesses vitamin A activity!

Some of the plant carotenoids are absorbed by animals and deposited or excreted unchanged, like carotene in the corpus luteum of the cow and xanthophyll in the yolk of eggs; on the other hand, they may be considerably modified; many animal carotenoids require study, as a reference to Palmer's monograph (1922) reveals. An example is the C_{40} carotenoid which is the red pigment of the lobster; before cooking, the lobster has a blue colour due to an absorption complex of this pigment with protein, which dissociates on boiling to give the familiar red. A similar carotenoid-protein complex has been related to the visual purple of the eye according to a NATURE correspondent.

Not the least useful outcome of the activity in carotenoid chemistry is the developments in contemporary chemical technique to which it has led. Microcombustion analysis made carotenoid chemistry possible, but its prosecution has led to the development of microhydrogenation, a method for determination of methyl side chains, and to the rediscovery and popularisation of a new method of purification of chemical substances, 'chromatographic adsorption'.

Prof. Zechmeister's monograph is the first to record the chemical knowledge of the carotenoids. It gives an excellent and detailed account of the individual carotenoids, the methods of establishing their structure, their distribution and determination in plants and animals, their relation to vitamin A, and it discusses their formation in the plant and their physiological rôle. There is a complete bibliography and a good index. It is to be welcomed as an authoritative work from one who, through his own researches, is well qualified to write on the subject, and whose own contributions to it have been important.

K. F. ARMSTRONG.

Modern Science for the Layman

The Architecture of the Universe. By Dr. W. F. G. Swann. Pp. x + 428. (New York: The Macmillan Co., 1934.) 16s. net.

MANY are familiar with the lectures on various general aspects of science which Dr. Swann, director of the Bartol Research Foundation of the Franklin Institute, has delivered in recent years. Their publication in the *Journal of the Franklin Institute*, *Science* and elsewhere has secured for them a wider public than that of their original auditors—a fact which, on account of their general excellence, is matter for satisfaction. Dr. Swann has now collected them to form a well-produced volume which can unhesitatingly be recommended to all who are interested in the broad significance of modern scientific thought.

The book includes twelve lectures which, though strictly speaking they are independent of one another, are yet arranged so as to present a rough approximation to continuity. It corresponds closely, the author tells us, to a course of lectures on the philosophy of physics given at Ohio State University during the summer of 1932. Starting with an account of medieval and modern dogmas in natural philosophy and the dawn of the modern era, it takes us through atomic theory, relativity and problems of space, time and the universe, to a concluding discussion, necessarily more speculative than that which precedes, of vital processes and the relations of science with theology.

It is superfluous to tell those who know Dr. Swann's facility in the popularisation of science that the book is trustworthy and interesting, though occasionally (as, for example, in the two references on p. 235 to the star "Krueger" instead of "Kreuger 60") the author betrays his unequal familiarity with all the subjects treated. Such blemishes, however, are few and unimportant. If we have a controversy with Dr. Swann it is less in his practice than in his theory of popular writing. "I cannot escape the belief," he writes in the preface, "that a great deal of the confusion which is frequently left in the mind of the layman after reading a popular presentation of some of the more abstruse branches of natural philosophy, is a result of an unnecessary subjugation of the philosophical and mathematical ideas." This may be so, but is not an unnecessary exaltation of the mathematical ideas a much greater and commoner evil? How many lay students of relativity, for example, have not been completely misled by talk of 'curvature' of space-time, having been induced thereby to search for a mental picture of something similar to the familiar curvature of a sphere? The whole conception is, of course, primarily a mathematical one. Its application to the sphere corresponds to the familiar notion of curvature, while its application to space-time corresponds to nothing so imaginable. Surely it would have been better if in popular presentation, the 'mathematical idea' had been eliminated and the theory expressed, as it easily can be, in terms of intelligible operations.

On the whole, however, Dr. Swann's exposition calls for little but praise. H. D.

Experimental Optics

Physical Optics. By Prof. Robert W. Wood. Third edition. Pp. xvi+846+18 plates. (New York: The Macmillan Co., 1934.) 31*s.* 6*d.* net.

PROF. R. W. WOOD'S "Physical Optics" was issued in 1905 and revised in 1911, when it was expanded by 150 pages, with nearly a hundred new illustrations. The new edition shows a similar expansion of 132 pages, but includes nearly 500 pages of new material, nine new plates, and more than 150 new illustrations. The photographs thus reproduced were, however, designed for use rather than for ornament, and are disappointing in comparison with the beautiful pictures which are often used to illustrate spectroscopic phenomena.

The book retains its unique character as a record of experimental methods and results, and is of special value as a guide to the contributions to physical optics which have been made in the laboratory of the author at Baltimore. It is difficult to realise that the second edition goes back to a date preceding the development of Bohr's theory of line spectra. Quantum theory was then covered by a couple of pages on the "very recent light-quanta hypothesis of Planck and Einstein", and the remainder of the book was based exclusively upon 'classical' methods of analysis. The new edition therefore provided an opportunity for writing up *de novo* the whole of the work done in applying the quantum theory to optical phenomena. In the hands of so keen an experimenter as Prof. Wood, the narrative takes on an unusual form, since it is founded on observation and consequent theory rather than conversely. The new chapter on "The Origin of Spectra" is therefore exceptionally well-adapted for readers who think more easily in terms of facts than of symbols; and the same features are seen in new chapters on resonance radiation and fluorescence of atoms and molecules, and in the reconstructed chapters on magneto- and electro-optics, in the course of which the spinning electron is introduced as a solution of the problem presented by the 'abnormal' Zeeman effect in light emitted in a magnetic field.

In his original preface, the author expressed the hope "that the perhaps too frequent references to experiments with which he has been more or less directly associated will not be taken as an indication of a lack of perspective". In view of this frank acknowledgment, the reader need not be unduly disappointed when he finds that other topics are dealt with much less adequately. Thus, in the new edition, refractive dispersion in the region of absorption is still discussed in terms of 'damping'; and the sections dealing with absorption are equally inadequate, since a well-qualified colleague has remarked that the author's commendation of Vierordt's spectrophotometer, which "would now be considered a museum specimen", is "about sixty years out of date". Similarly, in a field in which the reviewer is specially interested, an erroneous statement that the anomalous rotatory dispersion of tartaric acid depends on an optically active absorption band in the infra-red, has been deleted; but no new data have been added, and half a dozen measurements, made in 1858 by methods which have been obsolete for more than half a century, are still cited as adequate illustrations of this phenomenon. In this chapter, moreover, the author has abandoned his policy of describing facts rather than theories, since the only important addition is a summary of Werner Kuhn's theory of dissymmetrically coupled electrons, which is already becoming obsolescent in view of more recent work by Born. Readers who wish to learn about modern work in branches of physical optics not of special interest to the author must therefore be prepared to seek information elsewhere; but others will be equally grateful to him for leaving these alien topics to take care of themselves, in order to concentrate on those questions about which he can give so much interesting first-hand information. T. M. LOWRY

Short Notices

Science Museum, South Kensington. *Handbook of the Collections illustrating Electrical Engineering.* 2 *Radio Communication* By W. T O'Dea Part 1 *History and Development* Pp 95+35 plates (London H M Stationery Office, 1934) 2*s* 6*d* net

THE objects of the Science Museum at South Kensington, with its collections and science library, are to assist in the study of scientific and technical development, and to illustrate the applications of physical science to technical industry For the guidance of students and others visiting the Museum, a series of handbooks is in existence, illustrating the various collections exhibited. The book under review is one of those dealing with the electrical engineering collections It is, however, by no means a mere descriptive catalogue of what may be seen at the Museum It is rather a concise and well-presented history of the development of radio communication from the earliest discoveries of Hertzian waves up to the present-day achievements of telegraphy, telephony, broadcasting and television

The value of the work is considerably enhanced by the large number of photographs which illustrate the progress made in the plant and apparatus used for radio communication purposes Many of these items are quite obsolete, and the preservation of a knowledge of them, partly by exhibits in the Museum and partly by the illustrations in this work, is a valuable undertaking Of the few points in the book which call for criticism, one will be mentioned here Insufficient recognition appears to have been given to the very valuable technical work carried out during recent years by members of the staff of the British Post Office, which has been very largely responsible for the development of radio-telephonic communication to its present world-wide standard

Although technicalities have been reduced to the minimum, some knowledge of the technique of the subject is desirable on the part of the reader To the student, in particular, the book will provide a valuable historical supplement to his more detailed textbooks

Soil Analysis a Handbook of Physical and Chemical Methods. By C Harold Wright. Pp viii+236 (London : Thomas Murby and Co ; New York : D. Van Nostrand Co , Inc , 1934) 12*s*. 6*d* net.

THE number of analyses conducted every day on soils must be very large, yet apart from Gedroiz's and Lemmerman's works in Russian or German, and Wiley's "Agricultural Analysis", vol 1, there was until now no textbook on the subject. Most workers have had to get their information from sections in general textbooks or in the "Chemists' Year-Book", or from the original literature In the inevitable phrase, then, Wright's "Soil Analysis" supplies a long-felt want Moreover, it does so exceedingly well. Without being cumbrous, it is comprehensive ; and—a matter of particular importance in a subject where methods are revised and new conceptions are introduced as rapidly as in soil science—it is right up to date

There is a full array of chemical determinations, including those, such as ammonia and nitrate, useful to the microbiologist In addition, the book describes methods of determining physical constants, and making physico-chemical measurements, paying particular attention to soil reaction and base exchange. In footnotes and in tables of factors the author brings his own experience to the aid of workers who may be using a method for the first time The number of illustrations might usefully have been increased, but the book is well produced and commendably free from errors

Textbook of Abnormal Psychology By Roy M Dorcus and Prof G Wilson Shaffer Pp xiii+389 (London · George Allen and Unwin, Ltd , 1934) 16*s* net.

THIS is a most instructive and valuable work It is written by two psychologists who bring to their work a critical faculty and logical training that one does not always find in books dealing with abnormal, or for that matter normal, psychology.

When viewed from a medical point of view, however, there is a superficiality and vagueness which leaves a feeling of uneasiness The statement that . "Swingle and Pfiffner . have discovered an aqueous extract of the adrenal cortex which has proved astonishingly valuable in the treatment of cats " may sound thrilling, but what *were* the cats suffering from ? We would have liked to see some discussion of the relationship between the adrenal glands and emotion.

The writers might have emphasised that in true paranoia there is an absence of hallucinations, and that mental deterioration does not occur. The adjective corresponding to paranoia is paranoiac, not paranoid. Despite shortcomings which can all be corrected in the next edition, the book is on the right lines, and we welcome it.

Soviet Russia fights Neurosis. By Dr. Frankwood E Williams. Pp. xix+251. (London . George Routledge and Sons, Ltd , 1934) 8*s*. 6*d* net.

DR. FRANKWOOD WILLIAMS went to the U S S R. as a psychiatrist to see for himself the state of affairs. He found many strange and inexplicable conditions and views. Possibly the position is best summed up in the reply to a criticism of his , instead of answering the criticism the reply was evasive and turned at once to 'Yes, but have you seen the museum of the Revolution, the park of Culture and rest, a factory, a public kitchen ?' The planning is all there but the execution is another matter ; the Russian citizen seems to blind himself to those things he does not wish to see Is not the U S S.R. suffering from a mass obsessional neurosis ?

Respiration of Fruits*

MECHANISM OF RESPIRATION

DURING respiration, the entrance of oxygen and its distribution through the tissues to the individual cells of a fruit, also the reverse processes involving the giving off of carbon dioxide, take place by diffusion There is a fine network of channels ramifying through the tissues to aid such gaseous interchange The diameter of the pulp cells of the full-grown apple is about 150μ, and of the channels about 5μ. The surface of interchange is very large, being a square metre for a single fruit The intercellular space is 10–20 per cent of the whole tissue In such a system as this, there must be gradients of gaseous concentration, though it can be shown that such gradients are very small

The peel of the apple plays an important part in regulating gaseous interchange between the fruit tissues and the atmosphere The cells of the peel are smaller and more compact than those of the parenchyma beneath, and their outer walls are covered with a thick cuticle which is comparatively impermeable to gases But the peel is broken by a system of pores, which constitute a path of gaseous interchange. That the peel constitutes a resistance to the path of gaseous interchange can be shown by setting up two apples with 100 per cent atmospheres of carbon dioxide at their centres, one apple with the skin removed and the other with the skin intact The escape of carbon dioxide observed will be much greater in the former. Owing to the resistance to diffusion offered by the peel, the composition of the internal atmosphere differs considerably from that of air Conditions can easily arise which lead, through a conjunction of low skin porosity and high respiratory activity, to concentrations of carbon dioxide inside the fruit which are directly injurious So much has been definitely shown, but so far no thorough study of the internal atmosphere in relation to the variables affecting it during growth and storage has been carried out.

CHANGES IN RESPIRATORY ACTIVITY

Throughout its life-history, the apple shows distinct changes in respiratory activity These may be correlated with the five morphological and physiological stages which occur during the development of this fruit. First, there is the stage of *cell division* which lasts from fertilisation until about three or four weeks afterwards, when the fruit is about the size of a walnut. This goes on until about a hundred million cells are formed in a typical fruit, after which the number of cells does not appreciably increase The *enlargement* of these cells constitutes the second stage Then the fruit *matures* and produces aroma and flavour This is the third stage Now the fruit is ripe, and under natural conditions it falls from the tree The fourth stage follows as a longer or shorter period of *senescence* The fifth stage is the functional breakdown culminating in *death*

Respiratory activity is greatest at the beginning of fruit formation, at the end of cell division (first stage) it has fallen to about one fifth of its original value During cell enlargement (second stage), respiration continues slowly to decrease During the process of maturation (third stage), a critical change in respiratory activity occurs in that there is a sharp rise This may be called the *climacteric* Senescence (fourth stage) sees a slow decline from the peak of respiratory activity reached during the climacteric Finally, at death (fifth stage) there is a sudden rise followed by a fall to zero.

CHEMISTRY OF RESPIRATION

The most important substances connected chemically with the respiration of the apple fruit are sugars (fructose, glucose and sucrose), acids (mainly malic acid), starch and proteins

During the first stage, the proteins are the chief constituent of the practically non-vacuolate cells During cell enlargement, sugars accumulate from about 1 per cent to about 9 per cent fresh weight Vacuoles appear and occupy about 80 per cent of the cell volume In these, most of the sugars collect It is significant that fructose and sucrose are the sugars the concentration of which rises, while glucose remains relatively low and steady in concentration Starch accumulates in the cytoplasm up to about the middle of this stage, after which it diminishes to zero

Tissue oxidations are associated with enzyme catalysis, determined by (1) enzyme content and (2) content of respirable material So, to be more exact, the standard of reference should not be unit fresh weight as heretofore used, but unit *living matter*, thus omitting vacuole and cell wall. Considered thus, the fall during the first period is smaller and may be related to a decrease in enzyme activity In the second stage an increase in respiration occurs, due to the accumulation of the necessary fuel sugars.

If fruit is gathered during the second stage of growth, respiration rapidly falls Then there is a pause, followed by a continuation of the decrease The respiratory activity then settles to a steady decline. This is followed in due course by the climacteric rise, the senescent decline, and the final burst of activity falling away to zero (Fig. 1).

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* Substance of the Friday evening discourse delivered by Dr Franklin Kidd at the Royal Institution on November 9, 1934

The chemical changes in fruit gathered at this stage and stored are as follows. As soon as the fruit is gathered, the starch content declines and glucose content naturally rises. But, surprisingly, fructose, and sucrose also, rise. The end of the pause in initial fall of respiratory activity marks the final disappearance of starch.

As soon as starch is no longer present, the sucrose begins to disappear, the total fructose content remaining steady, while the total glucose content falls. Unlike starch, however, sucrose does not completely disappear. These changes are considered to complete the phase of adjustment to starvation conditions (Fig. 2).

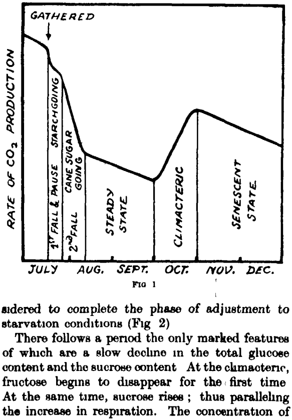

FIG. 1

There follows a period the only marked features of which are a slow decline in the total glucose content and the sucrose content. At the climacteric, fructose begins to disappear for the first time. At the same time, sucrose rises; thus paralleling the increase in respiration. The concentration of cane sugar and the rate of respiration reach a maximum together at the peak of the climacteric and thereafter decline together.

In explanation of these changes, the heterogeneity of the cell system and the probability that respired sugars are not equally distributed must be taken into account and also the fact that, after gathering, the cells are changing from a state of growth, and of supply and accumulation, to one of cessation of growth and of supplies. The theory advanced is that the sugar respired is active or γ-fructose. Other things being equal, the rate of respiration is determined by the concentration of this active sugar in the cytoplasm. The principal reactions determining concentration of active fructose are

(I) Glucose ⇄ active fructose → inactive fructose or other normal hexose (vacuole)

(II) Glucose + active fructose ⇄ sucrose (vacuole),

and the seat of these reactions is thought to be at the interface between the cytoplasm and the vacuole. It is further suggested that prior to the climacteric, sucrose and normal fructose do not as such penetrate from the vacuole into the cytoplasm. When the fruit is on the tree, glucose arrives at the cell wall and passes across the cytoplasm through a declining diffusion gradient. At certain points in the cytoplasm any excess of glucose above a certain concentration is condensed to starch. At the interface between cytoplasm and vacuole the conversion of some of the glucose into active or γ-fructose takes place, and the formation of cane sugar occurs.

The theory accounts for the accumulation of sucrose and fructose in the vacuole during growth and supplies an answer to the questions: Why, after gathering, are the cells unable to maintain a high concentration of cane sugar? Why, nevertheless, does the concentration of cane sugar rise after gathering so long as starch is present? Why, finally, does a steady low concentration of cane sugar occur instead of a complete disappearance as in the case of starch?

With the onset of the climacteric, it is supposed that the interface between vacuole and cytoplasm becomes permeable to normal fructose. This change in permeability is connected with the inner surface of the cytoplasm and possibly with the attainment of a critical hydrogen ion concentration in the vacuole. The acidity of the vacuole is due to the organic acid present. Whether the apple remains on the tree or is gathered, the acidity of the vacuole steadily falls from the beginning of the cell enlargement stage at approximately the same rate. This explains why the climacteric rise occurs very nearly at the same time, irrespective of date of gathering, since the acidity falls, in any case, at about the same time, to a certain critical level at which the climacteric occurs. Other evidence has been obtained that the acidity of the vacuole is the main factor in determining the onset of the climacteric.

STORAGE OF FRUITS

The climacteric marks the beginning of the production of odour and flavour. Experiment has shown that a substance is evolved during this stage—a substance toxic to seeds and destroyed by bromine. This substance is produced in such small quantities that its identification is not easy; but there are reasons for believing that it is the gas ethylene. The biological effects of the vapour from ripe apples and of ethylene on other plants are the same Both, for example, cause an immediate rise in the respiratory activity of other unripe fruit, and this rise bears every resemblance to the true climacteric rise of ripening Thus unripe fruits exposed to the vapour of ripe fruits begin ripening at once Such 'autocatalysis' can be prevented by treating air passing from the ripe fruit with ozone

Among other substances produced at the climacteric is a dense, slowly diffusing vapour which causes the browning of the skin of the apple Such deterioration can be avoided by very rapid ventilation with fresh air A more practical way, however, is to wrap the apple, *during the climacteric*, in tissue paper impregnated with an odourless mineral oil

The production of such gases during the climacteric is also responsible for increased susceptibility in apples to low temperature injury when kept in cold storage. How far the origin of these toxic substances can be traced to fructose is not yet known

INTERMEDIATE STAGES OF RESPIRATION

Fruit can produce carbon dioxide in the absence of oxygen by respiration Blackman and Parija have shown that the initial rate of such fermentative breakdown in a ripe apple is a function of *the oxygen supply prior to its removal* to anærobic conditions (nitrogen atmosphere) They therefore concluded that the first stages of sugar breakdown are anærobic in any case, and that oxygen has a stimulating effect on the supply of this sugar But this theory, though it explains the decline in respiration after removal of the fruit to anærobic conditions, does not explain why such decline is *not to zero* but to a constant level of activity Thus, although oxygen stimulates supply of respiratory sugar, it is not essential to it

Trout, realising that acetaldehyde is given off by ripe apples, and that this substance is also a recognised intermediate product during the fermentation of sugars, examined the effect of supplying acetaldehyde artificially to fruits When supplied slowly, the added aldehyde quickly became oxidised. On the other hand, when supplied quickly there was a definite rise in aldehyde content and at the same time ethyl alcohol appeared in the tissues The two processes of oxidative and fermentative breakdown appeared to be proceeding together with a consequent increase in rate of sugar loss. From this, Trout suggested that the fermentative process takes place as far as the acetaldehyde stage irrespective of oxygen present. After that, if much oxygen be present, the aldehyde is oxidised to carbon dioxide and water, or, on the other hand, if no oxygen is present, it reacts with methyl glyoxal, formed in the first splitting of the sugar The former process must be the more rapid one, and therefore in the presence of oxygen the concentration of aldehyde in the tissues is low When it is artificially raised, the reaction with methyl glyoxal occurs and the results obtained are to be expected If this hypothesis be correct, glycerol must be formed, but, since it is known not to accumulate, we must assume, following the Blackman theory of oxygen-anabolism, that glycerol is the substance which is re-synthesised to sugar

Experimental evidence suggests that the removal of oxygen from apples in the post-climacteric state is the elimination of the factor which produces the climacteric rise, that is, the entrance of fructose from the vacuole It is therefore suggested that Blackman's theory of the activation of sugar by oxygen during respiration applies only to the vacuolar fructose, and that activation is really the entry into the cytoplasm for which the presence of oxygen is essential If this is the case, then the climacteric rise should not occur in the absence of oxygen There is evidence that such is the case

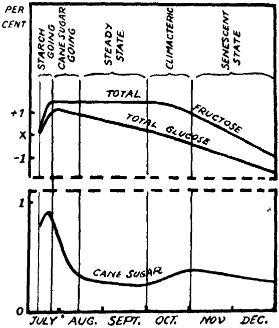

FIG 2

During senescence, a slow decline in respiration occurs. Aldehyde and alcohol increase during this period, *and it is suggested that this is due to* diminishing activity of the system for the oxidation of aldehyde by molecular oxygen Indeed, ageing apples become increasingly sensitive to lack of oxygen Quite a small decrease in amount of oxygen in the atmosphere causes fermentation in apples which are in an advanced state of senescence.

RESPIRATION AND LIFE DURATION

Fruits of a short life-cycle, such as the strawberry, exhibit a higher respiratory activity than fruits of a longer life-cycle such as the apple. Variation occurs, however, even within a species For example, in apples, the variety Bramley's Seedling respires at about two-thirds the rate of the Worcester Pearmain The life duration of the latter is about one and a half times that of the former Respiratory activity also varies with the nutrition of the fruit during growth Therefore, if respiratory activity during cultivation of the fruit be increased by increasing the nitrogen content of the soil, life during storage is shortened, and vice versa A more striking example, however, is the result obtained by gathering fruits at various stages during the second period of growth. At the beginning of this period, the cytoplasm and the cane sugar per cell are at their minimum, and so therefore is respiratory activity Fruit gathered at this stage will thus have a longer life during storage than fruit gathered at any subsequent stage

A young apple, in spite of the fact that it contains little carbohydrate when gathered, loses more carbon before death than does a full-grown fruit A full-grown fruit does not usually lose more than 0 2–0·4 per cent of its carbohydrate and acid prior to death. It appears likely that it is the 'rate of living' which kills and that the machine breaks down from wear and tear and not from lack of fuel

From these observations, three new agencies have come into use for the purpose of controlling the span and speed of life in fruits, namely: (1) use of ethylene as an accelerator of ripening, (2) use of carbon dioxide as a depressor of respiratory activity, thus retarding ripening and lengthening life, (3) the use of atmospheres poor in oxygen, thus reducing respiratory activity, delaying the climacteric and retarding ripening

The possible use of ozone in controlling ripening is still in the experimental stage

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The Teaching of Optics[*]

OPTICS and mechanics are twin Cinderellas in the teaching of elementary physics The beginner finds with growing disappointment that each covers ground remote from those thrilling matters of real life that they promised to deal with—remote from engines and machinery and from real optical instruments such as telescopes and microscopes To make matters worse, a confusing fight rages round the teaching of each . a battle of units in mechanics, in which the mass and the weight of the projectiles employed seem inextricably mixed, and a battle of signs in optics, with $1/v-1/u=1/f$ and $1/v+1/u=1/f$ as its war cries Mechanics has been rescued by the toy manufacturers—if we may call admirable constructional apparatus such as 'Meccano' toys—and the mathematical studies of mechanics which seem so artificial if attacked too early are left until the later school stages when they can bring a real delight unspoiled by disappointed hopes of romance.

Optics may follow a similar path with constructional sets of lenses and mirrors as Christmas toys to provide the practical delights that formal teaching often misses; and for several years such sets have been on sale, with optical components and adjustable framework for making a variety of working optical instruments. We grudge no toyshop such excellent wares, yet we cannot help feeling that elementary optical teaching is at fault and should itself capture and use some of the thrills that belong to actual instruments, before attempting to build a formal structure—an attempt long ago condemned in other branches of teaching Many teachers, feeling this, now begin optics with a course that is not merely simplified but wholly changed in order and emphasis, yet even they must feel the drag of examination demands, textbook styles and the weight of tradition So it is pleasing indeed to find that the Physical Society's Report urges that "The early approach to lens and mirror optics is best made along experimental lines, and every effort should be made to implant a sound conception of the main physical phenomena of image formation before mathematical formulæ are introduced", and suggests that an *experimental* start, free from mathematics, might be made with, "for example, elementary illumination and photometry, and the action of simple instruments such as the telescope, microscope and projection lantern". The Report says regretfully, "In only too many cases the beginning and end of optical instruction in schools seems to be bound up with $1/v - 1/u = 1'f$", a type of formula which, as one of the authors says later in the Report, is not much used in real optical work!

While the Report expresses these hopes for the future of elementary teaching, its main concern is with the conventions of signs in optical formulæ.

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[*] Report of the Committee appointed by the Physical Society to consider and make Recommendations on the Teaching of Geometrical Optics. Pp v+86 (London Physical Society, 1934) 6s net.

At present six or more different conventions are in use in textbooks in English Most teachers, and presumably all examiners, must wish that some competent authority would choose one convention and enforce its universal use But each wishes the chosen rule to be the one he uses himself, so the only chance of effecting a successful choice is for the pronouncement to come from a body of such high authority as to compel the agreement of teachers, examiners and authors alike This Report gives just such a pronouncement It is the result of five years work by a distinguished committee which included representatives of a wide range of optical and educational interests It carries such a weight of authority that its recommendations, though they can only be made as suggestions, ought to be accepted as law

The Report considers the current conventions of sign relating to formulæ such as $1/v \pm 1/u = 1/f$ From the half-dozen actually in use the Committee chooses two—the members themselves were unwilling to reduce their choice to one Reasons are given for this preference, and it is urged that one of these two should be adopted in future in elementary optical teaching, and so far as possible, in advanced teaching The Committee is unanimous in recommending that teachers in schools and universities should be asked to employ the practical opticians' convention which gives a positive power to a 'converging' lens, negative to a 'diverging' one As most school teaching at present uses the opposite convention, neither of the two general sign conventions recommended is in use in any school textbook, but both are as good and clear and easily grasped as those now in use So in schools the recommended changes will be slightly unwelcome to all at first, but ultimately very welcome

The recommendations include the following

(1) Converging lenses should be assigned positive power; diverging negative Focal lengths should have the same signs as powers, as far as possible

(2) That 'power' (equal in elementary cases, in air, to $1/(f$ in metres$))$ should be used in preference to focal length, where convenient

(3) That an instrument (without erecting mirrors or prisms) should be assigned positive power if it produces an inverted image of an infinitely distant object; negative if the image is erect.

(4) That the numerical value of the power of a system be measured by the small angle subtended by an infinitely distant object divided by the length of its image. (A corresponding definition gives the focal length, and the Report suggests that this be made the basis of a laboratory method for estimating—but most school laboratories lack the space and the measuring microscopes necessary for accurate use of this method.)

(5) That in more advanced work when refractive indices are inserted, all formulæ should be made homogeneous in μ or μ' For mirrors we should write $\mu/v + \mu/u =$ power, and power $= \pm 2\mu/r$.

(6) That the convention of signs be changed, in the course of time, to either of two recommended rules, described below as Group I (i) and Group II (i)

GROUP I (i) Distances measured from the lens or mirror are assigned *positive* values when measured in the *same* direction as the incident light and *negative* values when measured in the *opposite* direction For example, if a lens placed 20 cm from a real object forms a virtual image 30 cm on the other side, then $u = -20$ and $v = +30$ To obtain the signs for power required by the convention mentioned in (1) above, we must use $1/v - 1/u = 1/f$ for a lens, and $1/v + 1/u = 2/r$ for a mirror.

GROUP II (i) Distances are measured *along a ray* (instead of along the axis; but this makes little numerical difference in elementary practice and need not complicate the teaching) and are assigned *positive* or *negative* values according as the object or image to which they relate is *real* or *virtual* Distances are positive if light has travelled along them and negative if it only appears to have done so. Thus u has a positive value if the object is real and v has a positive value if the image is real, wherever it is This convention emphasises the distinction between the image space of, say, a lens, and the object space Each space extends on *both* sides of the lens, having positive distances on one side and negative on the other For a lens the positive portions of object space and of image space are on opposite sides, for a mirror on the same side For example, if a lens placed 20 cm from a real object forms a real image 30 cm on the other side, then $u = +20$ and $v = +30$. We must use $1/v + 1/u = 1/f$ for a lens and the same formula for a mirror

Both conventions apply equally to wave, ray or other treatments Both provide criteria for the signs of angles, magnification, etc I (i) requires only a change of sign from the form common in school teaching, but II (i) promises certain extra attractions, since it uses the same formula for lenses and mirrors, seems to be able to carry a beginner through the thick and thin of an optical system at least as easily as I (i), welcomes the beginner's wish to call both u and v positive when he first experiments with a lens forming real images, and even allows him to forget which is which On the other hand, II (i) requires a rewriting of texts, and some students may not find it so easy in advanced work

We feel that the change to at least some measure of uniformity in optical teaching must be made—school teaching and the whole of commercial and ophthalmic practice cannot both have their own way unless the present diversity is to continue—and these recommendations provide the chance to make it They deserve the support of all future textbooks, and even, so far as possible, advanced treatises The revising of existing textbooks to conform with them would give trouble to publishers rather than to authors Every publisher of scientific textbooks should keep a copy of the

Report, for the benefit of authors as regards new textbooks, and for his own benefit, as regards reprinting existing books. Examining bodies could help by expressing, with increasing firmness, their preference for the new conventions. But the real demand for willing help must fall on the teacher, and we hope that all concerned with the teaching of elementary optics will be willing to welcome the change when the opportunity for it reaches them, and even, if they feel they can, to initiate it themselves meanwhile. All such teachers should examine this Report. At first glance it seems to sweep with dismaying rapidity through a mathematical optics that is quite beyond a school syllabus, but on careful reading it shows its authority and its value even for the most elementary teaching. The appendixes should be read together, and not taken as restricted each to its own convention. Each develops methods and proofs applicable with any convention. The examples seem rather ill-chosen for illustrating the use of signs in elementary work, but on closer examination do reveal the working of the rules, and as solved independently by two experts they are really entertaining.

The Committee does not wish to restrict the liberty of the teacher as regards methods of approach and treatment of the subject. The only restrictions it wishes to impose are concerned with routine matters such as conventions of sign. There has been ample opportunity for discussion of rival conventions, and now that a pronouncement has been made it is to be hoped that in the course of time all will comply with these recommendations. Not to do so would seem to be to deny the readiness of scientific workers to accept a simplification of unnecessarily complicated affairs. E. M. R.

Obituary

DR. MICHAEL GRABHAM

IN the death on January 28 of Dr. Michael Grabham at the great age of ninety-five years, the island of Madeira has lost its most influential personality and the world an enthusiastic naturalist. Dr. Grabham, who was educated at King's College, London, and the University of London, qualified in 1861 at St. Thomas's Hospital and served there as house surgeon. He married Mary Blandy, one of the well-known family of merchant shippers, in 1865, and took up permanent residence as a practitioner on the island of Madeira. In that favoured island he produced a book dealing with its every aspect—natural and sociological—a treatise that is still of outstanding value despite the changing times.

Dr. Grabham usually paid a flying visit to his home country every summer, where he was recognised by many distinguished bodies. He received the degrees of M.D. and LL.D. from the University of Aberdeen, F.R.C.P. from the Royal College of Physicians, which he represented at the Geological Society's centenary meeting in 1907. In 1921 he delivered the Bradshaw lecture before the College. He delivered discourses at the Royal Institution and read papers on the climate and natural history of Madeira before the British Association, of which a few years ago he became the senior member. His last paper before the latter body was read in his eighty-eighth year and dealt with the subtropical deep sea food fishes of Madeira.

The Zoological Society of London some years ago established a collecting station in Madeira and to-day can show an unrivalled series of 'Madeira tanks' in its aquarium, each displaying some aspect of the wonderful fauna which exists in the island's coastal waters. For this exhibition Dr. Grabham is partly responsible, since he was first to suggest making Madeira a base of operations. Dr. Grabham, although not a professional marine biologist himself, was an enthusiastic aider and abettor of all who made marine biology their peculiar interest.

Among Dr. Grabham's numerous activities were music and the collection of clocks. In the former art he proved himself specially gifted, and when visiting London had on more than one occasion the privilege of giving organ recitals in St. Paul's Cathedral. His collection of chiming clocks numbered more than two hundred, and the writer well remembers his sensations on first spending a night at his host's home at Quinta do Val, when the numerous timepieces solemnly announced the midnight hour for fully sixty minutes before and after Greenwich had agreed with his own watch as to the precise moment of that event.

Dr. Grabham leaves two sons and one daughter, one of the former, Mr. Walter Grabham, being the Government geologist in the Sudan; his daughter, Mrs. E. B. Carter, has her own home in Madeira at Santa Cruz, where she spends her holidays and supervises the collecting operations on behalf of the Zoological Society.

Dr. Grabham had many friends, and the loss of his charming and energetic personality will be deeply felt by a large circle of friends both in Great Britain and in his island home. E. G. BOULENGER.

MR. HERBERT G. PONTING

THE death of Herbert G. Ponting on February 8, at the age of sixty-four years, removes from us perhaps the greatest of all polar photographers, a pioneer in the application of artistic photography to the purpose of a scientific expedition.

The early part of Ponting's life was spent in a diversity of occupations; and he took to photography from the unusual atmosphere of agriculture and mining in the western United States. He rapidly made a name for himself by his pictures in Japan and China, and he was already well known in photographic circles when, at the age of forty years, he joined Capt. Scott's last expedition. Here he mixed, possibly for the first time, with a number of men of science who, aware of his reputation, besieged him with special work on their behalf. His reaction to these requests was typical of the man. His kindness of heart would urge him to take exactly what was required of him, though his artistic sense would rebel against banal subjects that he was set to record. Nevertheless, he would take hours endeavouring to make a real picture from such unpromising material as a cliff face or stratification in a glacier.

Ponting always maintained that he was not a photographer but a camera artist, and this was truer of him than it could be of most who claim the latter name. He was a merciless critic of his own work, and would destroy all negatives which did not come up to the high standard he set himself. The noise of breaking glass in his dark room was not uncommon, and usually heralded his reappearance, laden with cameras once more, to go and take his subject over again. His cinematograph work was at that time in advance of that done by any previous film traveller. The world has only seen a small fraction of the footage taken by him, and he probably spent more actual time with his cinema than with his still camera. Here again, however, his work could not be called scientific in the purest sense, largely because the artist in him quarrelled with the man of science, and usually won.

Although Ponting was devoted to his work, and had few interests outside it, he recognised its commercial value, and this brought him into touch with the financiers of the film world, a milieu unsuited to his temperament and one in which his experience was not always happy. On visiting him at his London flat, one was sure to find him either in the depths of despair at some plans gone awry or full of enthusiasm at some new venture, usually connected with the exhibition of the Scott films.

Ponting had a simple and generous mind and he suffered very deeply at the loss of Scott and Wilson. He devoted himself for many years to the task of perpetuating their memory through his still pictures and his films. Those who have enjoyed them will acknowledge his success, and many of his camera studies will endure for all time as perfect examples of his art.

PROF. O. D. CHWOLSON

PROF. O. D. CHWOLSON, of the University of Leningrad, who died on May 11, 1934, is well known as the author of a textbook of physics, originally published in Russian and later translated into German, French and Spanish. It was one of the first textbooks written for high school students and enjoys a deservedly high reputation. Its success has been due to the masterful treatment of the subjects by a highly gifted lecturer and teacher. The first four volumes were written by Prof. Chwolson himself; the last volume consists of chapters written at Prof. Chwolson's request, and on the lines he indicated, by specialists, his pupils, in various branches of modern physics.

Prof. O. D. Chwolson was born in 1852 as a son of a well known Hebrew scholar. He matriculated at the age of seventeen and took up his studies at the University of St. Petersburg. He graduated with honours in 1873. The next year he spent in research at Leipzig, but in 1875 he was back again in Russia. He took his 'master's' degree in 1876 and his doctorate in 1880. His early research work dealt with various questions of electricity and magnetism, as well as with actinometry. The work on actinometry was preceded by some investigations on the mathematical theory of conduction of heat, and the result was an actinometer which for a long time served as a standard type instrument in Russian meteorological observatories.

After 1876 all Prof. Chwolson's work was devoted to teaching, and among the numerous students of fifty years, there was scarcely one who was not fascinated by his lectures. He knew how to address the beginners as well as advanced students, his lectures being carefully prepared.

Prof. Chwolson took an active part in the teaching of physics in secondary schools and especially in the training of teachers. In 1907, he organised a committee for the investigation of the provision for physical laboratories and demonstration rooms in secondary schools, and in 1913, a meeting of teachers in physics, chemistry and geophysics in secondary schools. He was elected permanent honorary president of the section of teaching of the Russian Physical and Chemical Society.

The great gift of popularisation of scientific achievements added considerably to Prof. Chwolson's activities. Most of his lectures were afterwards published and make very pleasant reading. His books appeal to the average man just as well as to the scientific worker. Only a few years ago Prof. Chwolson published a book on "Modern Physics", dealing with the latest achievements in physics. Some 300,000 copies were published, so great was the demand for it in the U.S.S.R.

It is scarcely possible in a brief obituary notice to give an appreciation of Chwolson the man, modest, hard working and with true enthusiasm for scientific knowledge. The world has benefited from his philosophical conceptions and from his ideas about the influence of science on social life. Several generations of physicists, not only in the U.S.S.R. but also in other countries, will keep his name in grateful remembrance.

WE regret to announce the following deaths:

Dr. James Clark, emeritus rector of Kilmarnock Academy and formerly principal of the Central Technical Schools for Cornwall, Truro, on February 19.

Dr. Axel Wallén, director of the State Meteorological Hydrographic Institute of Sweden and president of the Meteorology Association of the International Union of Geodesy and Geophysics, on February 23.

News and Views

Lord Bledisloe and New Zealand

ON many occasions since Lord Bledisloe became Governor General of New Zealand in 1930, we have referred to stimulating addresses delivered by him on applications of scientific knowledge to agricultural and other industries, and to economic and social problems In all his addresses, the great importance of research has been emphasised and the results of investigations carried out in Great Britain and in other parts of the world have been brought before the people of the Dominion This has been particularly the case with agriculture, on which subject Lord Bledisloe is himself a high authority It is gratifying, therefore, to learn from a message from the Wellington (N Z) correspondent of *The Times*, that more than 54,000 dairy-farmers have subscribed to an address from their industry recording his thorough understanding of their problems and his assistance in solving them Scientific societies and the newspaper Press in the Dominion have similarly expressed grateful appreciation of his wise counsel and practical guidance

Lord Rutherford's Portrait for New Zealand

DURING his term of office, which closes on March 15, Lord Bledisloe has lost no opportunity of emphasising the important part which science has played, and must continue to play, in the development of the country The most distinguished scientific worker which New Zealand has produced is unquestionably Lord Rutherford, whose name will always be associated with the advance of atomic physics, and Lord Bledisloe proposes to mark the conclusion of his five years of office by presenting to the Dominion a portrait of Lord Rutherford, to be hung in the new National Art Gallery at Wellington By a fortunate coincidence, a distinguished portrait painter who is also a New Zealander, Mr Oswald Birley, was available for the task Mr Birley painted a portrait of Lord Rutherford which was presented to the Royal Institution by fellows of the Royal Society some three years ago Lord Bledisloe therefore commissioned Mr. Birley to paint a replica, which has been sent to New Zealand The presentation will be made at a civic reception to Lord and Lady Bledisloe to be held in the Town Hall, Wellington, on the eve of their departure for England By this public-spirited action, Lord Bledisloe has given New Zealand a striking picture, by one of her own artists, of a son who has achieved an international reputation in the field of science

Death of Lady Dewar

THE death on January 7 of Lady Dewar, widow of Sir James Dewar, was reported to the members of the Royal Institution at a recent general meeting Lady Dewar's long and intimate association with the Institution began in 1887 when her husband, already the Fullerian professor of chemistry, succeeded Tyndall as superintendent of the House. From that time until Sir James Dewar's death in 1923, she was the hostess of the Institution, and the regard in which her memory is held by a wide circle of members and friends is expressed in the words of Sir William Bragg at the general meeting Sir William said that her death "had broken a precious link connecting the present times with those of the past in which Sir James Dewar had made the Royal Institution such a powerful agent of research and exposition Not only had Lady Dewar been the true helper of Sir James in his work she had, as many would gratefully remember, been a most able and kindly hostess to the scientists and others who flocked to see her husband and the Institution over which he presided The members of the Institution would gladly acknowledge their debt to Lady Dewar, and for ever keep her name in appreciation and affectionate remembrance "

Lady Dewar's Bequests for Science

A BEQUEST by the late Lady Dewar is announced of ten thousand pounds to the Royal Institution The gift is free of duty, and is made on the condition that the income is to be used for the purpose of furthering scientific research in the Institution and as a permanent memorial to the work there of her husband, Sir James Dewar Lady Dewar has also left to the Royal Institution her husband's medals and diplomas and his scientific papers and apparatus, together with a sum of money to provide accommodation for them A large part of his apparatus, in particular that used in his low temperature researches, has remained at Albemarle Street since his death, and in recent years has been displayed in the Institution's collection The papers and objects now presented are additional material likely to be of great historic value to the Institution in relation to the period of Dewar's professorship Lady Dewar's other bequests include £4,000 to the Royal Society's Mond Laboratory at Cambridge and £3,000 to the Royal Academy of Music The residue of the estate is left for the furtherance of research in chemistry and physics at one of the Universities of Edinburgh, St Andrews, Glasgow or Aberdeen, or for the assistance of bacteriological research in connexion with the Royal Infirmary of Edinburgh and the Glasgow Royal Infirmary

Archæological Discovery in Honduras

AN important discovery in the ruins of Copan, the ancient city of the Maya in Honduras, is reported in *The Times* of February 21 An expedition of the Carnegie Institution of Washington, now working at Copan under Dr Gustav Stronsvik, in exposing a large stone staircase, has found an extensive system of canals and sewers connecting a massive series of buildings, which is now underground The buildings thus revealed include amphitheatres in which are monoliths and large statues in stone A statue of a warrior is described as of gigantic size Other discoveries are cruciform rooms, of which the floors are covered with red paint, and among the artefacts are a number of bead-collars. Of even greater importance for the archæologist is a pair of solid gold boots, nearly two inches high, of exquisite workmanship. With two doubtful exceptions, objects of worked gold have not been found hitherto in that period of the Maya civilisation to which the ruins of Copan are assigned. Unless further and more intensive study should point to a foreign origin, these boots of gold must be accepted as evidence that the Maya added no little skill in this technique to their artistic accomplishment, and that a neglect of gold-working, which has always seemed somewhat surprising, has been attributed to them in error. Further details of the stone statues and monoliths will be awaited by archæologists with the greatest interest, as owing to the conditions of discovery, they should throw further light on the development of the Maya art of stone carving, for which the site of Copan is already remarkable among Maya remains.

COPAN, situated in the modern State of Honduras, lies in what was the southern area of Maya occupation, and was the fourth city to be founded after they had entered the country. It belongs to the 'Old Empire' or early Maya period and was occupied in at least the period from 195 A.D. until 540 A.D. This minimum period is derived from Mayan dates carved on stelæ found on the site, which are correlated with the Christian era according to a generally accepted interpretation. Copan is one of the most extensive and important of Maya sites. Its ruins consist of a vast complex of buildings which were reconstructed time and again in the course of occupation. Structural remains cover nearly the whole of the Copan valley. Recently, however, the site has suffered much from the effects of earthquake, and the river has begun to encroach on important parts of the ruins. In the circumstances, the Mexican Government has asked for the assistance of the Carnegie Institution's Expedition, which has had its headquarters at Chichen Itzá in Yucatan for some years and has had much experience in the restoration and preservation of Maya structures. Of this co-operation the present discovery is an outcome. Dr. Stronsvik reports, according to a communication issued by Science Service, Washington, that a part of the bank has collapsed into the river, and a beautifully carved chamber excavated fifty years ago by the late A. P. Maudslay, the well-known British archæologist, has fallen in. The landslide has left a vertical section of the ruins about a hundred feet in height on the eastern side. Dr. Stronsvik is of the opinion that the Maudslay chamber can be reconstructed, but the material carried away by the river is irrecoverably lost. As a minor mitigation, however, the landslide has revealed an instructive cross-section of the city's development.

Pygmy Man in India

A REMARKABLE report has come from Bombay of the discovery of the fossilised remains of a pygmy man in Baroda State. According to the account from the correspondent of *The Times* in the issue of February 21, the discovery was made at Vadnagar in the Mehsana district of Baroda. The remains were said to have been found in a prehistoric step well, 150 ft. long, and were those of a man 15 inches high. With them was a cow 18 inches high; nearby was a stick 10 inches high. The correspondent of *The Times* went on to point out that the discovery might call for a new orientation of theories concerning the cradle of the human race and the origin of civilisation which would no longer be traced to Java, or the valley of the Nile or the Indus, but rather to the valley of the Narmada. He also referred to Homer's story of the battle of the dwarfs and cranes and the report of Ctesias in the fifth century B.C. of the existence of a dwarf race in the heart of India. Even if the report were taken seriously—it has been stated to be a hoax—the discovery of a single specimen of so remarkably an aberrant character would be scant foundation "to prove the existence of an extinct race of pygmies more diminutive than that in Africa". Most ethnologists postulate a negrito strain in the Indian peoples which may have been derived from a diminutive race, not of some unknown extinct form, but analogous to one of the pygmy peoples, which extend, with intermissions, from West Africa to New Guinea; but these peoples are a highly specialised rather than a primitive type and their stature does not, as a rule, fall much below four feet six inches. Ethnological theory, for the moment, remains unshaken.

High-Altitude and Long-Distance Flights

THE Air Ministry has recently authorised the construction of two new experimental aeroplanes, one for high altitude and the other for long distance flights. The high-altitude machine will presumably be used for exploring the question of flight in the stratosphere, which is usually taken to mean that region in space above a height of 28,000 feet. There are plenty of aircraft in existence capable of reaching heights greater than this; the present record is 47,356 ft. held by the Italian pilot Donati, but no attempt has yet been made to deal with the possibilities of economical flight at such heights. The ultimate possibilities in this respect are much greater speeds owing to the reduced resistance of the rarified air. It will be necessary to carry superchargers to supply the required oxygen for the combustion of the engine fuel, appliances for breathing and heating, air-tight cabins or special suits for the occupants, and propellers the pitch of which can be changed to suit the different air conditions. These extras will have weight, which will reduce the fuel carrying capacity of the machine, and it is not impossible that this requirement alone will limit the practical utility of stratosphere flying.

THE time taken to climb to such heights will be considerable, which will possibly make the proposition not worth while except for long flights, where again lack of fuel capacity will place a limit on it. Such flights are not likely to have any immediate application to air transport, but their importance in the experimental sense is obvious. The long-range experiments have a more definite application both to civil and service flying, where the question of the proper balance between quantity of fuel carried—to the exclusion of useful load—and the necessity for landing for further supplies, is essentially a practical one, peculiar to the geographical conditions in different parts of the world These experiments should also further the development of the compression-ignition heavy-oil engine, the smaller specific fuel consumption of which makes it particularly applicable in this case

Future of Lighter-than-Air Craft

THE announcement that the Secretary for the U S. Navy will oppose any further construction of airships to replace the wrecked *Macon* presages the end of large rigid airship activities in that country. Germany is now the only country, so far as is known, to continue experiments with these craft in increasing sizes, the new larger Zeppelin, to be called the *Hindenburg*, being now near completion It is significant that Dr Eckener of the Zeppelin Company has succeeded where others have failed, probably because with faith and perseverance he has acquired that kind of knowledge and experience in design, and assembled a staff skilled in the technique of construction, maintenance and handling, which can only result from practical experience. Germany has now been building large airships continuously since 1910, and even up to 1914 claimed to have flown 80,000 miles and carried more than 37,000 passengers The present *Graf Zeppelin*, launched in 1928, has crossed the Atlantic 62 times without serious mishap The only large airship in the United States that is still in an airworthy condition, the *Los Angeles*, is a Zeppelin type built at Friedrichshafen

IT is claimed nowadays that for long-distance commercial flying the airship is threatened by the large flying boat, which unquestionably has superior speed, but has not yet attained a comparable range. The latest projected flying boats only claim to be able to fly the Atlantic non-stop with a favourable wind As a naval scout, if it can be protected from attack, the airship is still unrivalled It can patrol trade routes far outside the range of aeroplanes, and its vision must be greater than any surface cruisers It is also reasonably independent for action of the movements of its own surface vessels, a decided drawback of aeroplanes carried by the fleet.

Fundamentalism Undefeated

A CABLE message dated February 20 from New York which has appeared in *The Times* states that on the previous day the House of Representatives of Tennessee defeated a motion to repeal the State law which prohibits the teaching of any theory that man is descended from a lower order of animals. The vote against repeal was 67 to 20, and the opposition to the repeal was led appropriately by the oldest member of the House, who opened his case by reading the first chapter of Genesis. It will be remembered that about ten years ago a young teacher of biology, J. T. Scopes, was convicted and fined at Dayton under this law. The case aroused great controversy in the United States, and was outstanding because of the eminence and the oratory of the counsel employed on each side Perhaps it was outstanding also as a picture of the simple faith which holds that truth can be decided by lawyer's arguments, and that scientific fact can be settled by majorities. Fundamentalism is by no means dead in Great Britain, but with the growth of knowledge it is dying

Musk-Rats in Scotland

SINCE the musk rat campaign was commenced by the Department of Agriculture for Scotland, in October 1927, the official trappers have killed 945 individuals To this must be added 60 killed by private persons, a total of 1,085, the progeny of five females and four males which escaped from an enclosure in Perthshire in 1927 Even the artificial pond on Gleneagles Golf Course has yielded five since the beginning of November 1934 (*Scottish Naturalist*, 1934, p 11) As a rule, the traps were laid at the mouth of a burrow, and a remarkable fact is that they did much more damage to other wild creatures than to the musk-rats themselves Mr. T. Munro, who supervised the work, records the death in traps set for musk-rats of 1,745 brown rats, 2,305 water-voles, 57 weasels, 36 stoats, 2,178 moorhens, 101 ducks, and a miscellaneous collection of birds, including amongst others 23 seagulls, 13 redshanks, 28 snipe, 15 blackbirds and a solitary kingfisher—a list of misadventures which runs to 6,587 items It is possible that this very considerable slaughter cannot be avoided, but apart from the brown rats the majority of the wild creatures slain are harmless, if not even useful from the human point of view, so that every effort should be made to confine the work of the traps to the pests they are meant to capture

Moving Biological Diagrams

MANY of the living processes of organisms can be illustrated most effectively by cinema films taken through the microscope, and with Mr Walt Disney's technique, diagrams could be shown in the same way for educational purposes. The American Genetic Association has applied this principle in publishing "Biological Movie Booklets" to illustrate cell division, fertilisation and meiosis, and it proposes to deal later with the more intricate processes of heredity in *Drosophila*, crossing-over and so forth (Biological Movie Booklets Vol. 1: Normal Cell Division. By Clyde E. Keeler. Pp. 46. Vol. 2. Maturation of Sperm. By Clyde E. Keeler. Pp. 94. Vol. 6: Fertilization. By Clyde E. Keeler. Pp. 65. Washington, D.C.: American Genetic Association, 1929. 3 vols, 1.50 dollars). Successively releasing the leaves of the booklets brings these dead diagrams to life, and for those who have not learnt to make the mental translation of diagrams into movement the effect should be improving. For those who have passed this stage the effect is still amusing, provided that the leaves are turned over quickly. Taken separately, however, the figures seem to be drawn, not from life but from an early or popular textbook. The descriptive text is correct for 1908. The draughtsmanship is not expert and the drawings should have been reduced from a larger size to conceal its defects If a future generation is to learn its biology this way, it is to be hoped that the publishers will take their task more seriously and remedy these shortcomings

Acquisitions at the British Museum (Natural History)

RECENT acquisitions by the Department of Zoology include a specimen of the frilled shark (*Chlamydoselachus*) caught by a trawler off the west of Ireland. This is the first occasion on which this species has occurred in British waters It was first discovered off the Japanese coasts The frilled shark is of great interest on account of the many primitive characters which it possesses The mouth is at the end of the snout, instead of being underhung as in most living sharks There are six gill openings on each side instead of the usual five, and the teeth are of a curious comb like shape The body is much more slender and eel-like than in other sharks, and in several ways it approaches some of the very ancient types of fossil shark-like fishes. Through the generosity of the trustees of the Salisbury, South Wilts and Blackmore Museum, the Department of Geology has received a large number of fossil invertebrates and fishes, forming part of the collection made by the late Dr H P Blackmore from the Chalk in the vicinity of Salisbury. A further valuable instalment of 488 specimens of Swiss minerals, representing 59 carefully recorded localities, collected by himself, has been presented by Mr. F. N. Ashcroft to the Department of Minerals

THE Department of Botany has received a bequest of Mr T J. Foggitt's British herbarium This numbers 4640 sheets of well-gathered and beautifully preserved plants Mr Foggitt was a well-known Yorkshire botanist, the son of the T J Foggitt who collaborated with J. G Baker in the formation of the Botanical Exchange Club which brought Thirsk into botanical prominence in the sixties of last century The herbarium is rich in Yorkshire plants, and is a welcome addition not only for this but also on account of the large number of extremely rare plants it contains. The Siamese collection of Dr A. Marcan has been purchased. It contains abundant material of 2772 numbers including several co-types. It has been named for the most part by the late Prof W Craib and Dr. A. Kerr The collection forms a valuable addition to the Department which is weak in Siamese plants A further set of Dr. H. Schlieben's Tanganyika plants numbering 146 has been purchased. The first two fascicles of Lundell and Nannfeldt's "Fungi exsiccati suecici praesertim Upsalienses" has been presented by the Elias Fries Committee. This exsiccata is of especial interest as it consists mainly of fungi collected in the neighbourhood of Uppsala, a region made famous by the classical works of Elias Fries.

Rural Electrification in Russia

ONE of the results of the first five-year plan is to change fundamentally the character of farm work in the U S S R Instead of a million small holdings, there are now only some thousands of large collective agricultural and pastoral farms Horse traction and manual labour are rapidly being replaced by the mechanical tractor and electrically driven machines and implements Electrification is the key note of the industrial reorganisation of the country In the *Electrical Review* of February 22, G Shapiro gives a description of some of the new agricultural and dairy farming methods Experiments on electrical haulage and electric tractors for ploughing have proved most satisfactory The electric tractors used for ploughing were usually converted mechanical tractors in which the internal combustion engines had been replaced by electric motors. The results show a considerable saving in working expenses Excellent results are being obtained with electric threshing, which is developing very rapidly These machines are produced in Kharkov, and are driven by electric motors Electrically driven machines have also been successfully experimented on in connexion with vineyards, tea plantations and cotton fields. In dairy farms, electricity will be used for milking, cleaning the animals, preparing food, water pumping, ventilation, butter making, cheese making and lighting Pig farms and poultry farms also take an appreciable electric load Researches are being made on the heating of the soil and the influence of light and various rays on seeds, roots and poultry and animal breeding By the end of the second five year plan (1937), it is anticipated that about 30,000 stations will be threshing electrically and will cover a sowing area of about 30 million acres

Aerodrome Lighting for Night Flying

OWING to the steady increase in the number of passengers and in the volume of the mails carried by aeroplanes, the proper lighting of aerodromes has become of great importance In the *G.E C. Journal* of November, Mr W A Villiers describes the equipment produced by the General Electric Company for this purpose. The problem is to give the pilot of an aeroplane flying on a dark night the guidance he requires to make a safe landing In many cases at the present time, aerodromes are only a few miles apart, he must therefore be able to identify the place with certainty This is done by means of a beacon The light must be visible in all weathers, but must not be dazzling The colour and character of the light should be different from that given by neighbouring beacons The beacon is in the shape of a truncated cone about 14 ft high, formed of six hairpin-shaped neon tubes giving the usual red neon colour It has low intrinsic brilliancy, but in favourable weather conditions can be seen at a distance of 50 miles. The identification is usually effected by making it flash in Morse characters the initial letter of the aerodrome. The boundary of the landing place is marked out by electric lamps inside orange glass globes. All landings are made against the wind as this direction gives the safest landing The landing ground should always be flood-lighted, the space being so large that even the fastest aeroplane does not overrun the lighted area Nine Osram lamps each taking a kilowatt are used for this purpose. Views are shown of the flood lighting employed at Croydon air-port.

American Amaryllis Society

THE first year book (1934) of this Society has recently been published under the editorship of Dr Hamilton P Traub (Orlando, Florida , 2 dollars) Plants belonging to the genera *Amaryllis*, *Hippeastrum*, *Crinum*, *Zephyranthes*, *Alstromeria* and others are the special objects of the Society, though its interest can reasonably be expected to include such well-known plants as snowdrops, daffodils and snowflake (*Leucojum*). A useful classification for show purposes has been prepared, and the Fischer colour chart has been adopted as the standard of colour nomenclature Botanical descriptions of the Amaryllideæ according to Baker are given, and many pages are devoted to the breeding of the various species Other sections deal with propagation and culture, whilst insect pests and diseases receive brief mention Storage, forcing and marketing are also discussed One of the most noticeable features is the brevity of each contribution, for nearly seventy articles are included in the 102 pages of the volume The memory of Henry Nehrling, a noted raiser of *Amaryllis* plants, is honoured by dedication of the first year book

The Observatories Year Book 1932

THIS important publication of the British Meteorological Office (Air Ministry) contains a very large mass of meteorological and geophysical information, obtained at the five observatories of Lerwick, Aberdeen, Eskdalemuir, Valencia and Kew, together with upper-air observations made by sounding balloons (London H M Stationery Office.) Its appearance has been slightly delayed owing to a change in its mode of production hitherto it has been printed, but in the present issue most of the extensive tabular matter, and part of the text, is reproduced direct from typescript by the Replika process of Messrs. Percy Lund, Humphries and Co , Ltd There is a certain loss in legibility and appearance, but this disadvantage is on the whole outweighed by the reduction in cost thus achieved , the reduction is passed on to the purchaser, since the "Year Book" now costs two guineas (postage extra) instead of three as for the preceding volumes The volume provides a very important record of the meteorological and magnetic conditions over the British Isles during 1932.

American Expedition to Tibet

AN expedition of the Academy of Natural Sciences of Philadelphia has recently left Yachow in Szechwan Province, China, for a year's survey of the zoology of eastern Tibet. The party is under the leadership of Brooke Dolan of Philadelphia who, with some of his staff, has had previous experience in the western China area Its main object is to obtain information and material for habitat groups of typical Tibetan animals, such as the wild yak, wild horse, ammon sheep, snow leopard, Tibetan gazelle and bear ; and as an aid to this end motion pictures will be taken of the wild game, which is said to be abundant on the high steppes of Kuku-nor and Tsaidam Mr Dolan's party is working in co-operation with the Metropolitan Museum of the Academia Sinica in Nanking It is gratifying to find that expeditions in out of the way parts of the world are concentrating more upon observation of animal distribution and habits than upon the unrestrained collecting which was often divorced from any sort of ecological observation

Age of a Stone Curlew

A SHORT note (*Proc Roy Zool Soc N S Wales*, 1933–34) records the presence in a suburb of Sydney of a fine specimen of stone curlew, which has attained a great age for such a bird He was brought to Sydney in his third year, and by the end of 1934 he will have passed his twenty-ninth birthday , during all the time he has been allowed absolute freedom in the garden More information regarding this interesting bird would have been welcome On what has it been fed during these years, for the food of waders is not always easy to obtain ? Also, has it ever shown any movements suggestive of a desire to migrate at the proper season ?

International Inquiry into Television

THE Rome correspondent of *The Times* states that the executive committee of the Institute of Educational Cinematography has decided to set up an international committee to study the problems raised by television The committee, which will be composed of representatives of national organisations in Europe and America interested in television, will inquire into the condition of television in the various countries and the questions raised by its practical utilisation ; the relations between television and cinematography ; and the use of television for cultural and educational purposes

Scientific Research in Japan

THE report of the National Research Council of Japan for the year ending March 1933 shows that, during the year, meetings of the following divisions of the Council were held . administration, astronomy, geophysics, chemistry, physics, geology and geography, agriculture, medical sciences, engineering and mathematics. Each division has sectional committees which deal with branches of the work, as for example, dyestuffs, industrial research and radio research ; and delegates attended the meetings of the International Unions of Astronomy at Cambridge, Mass , and of Mathematics at Zurich. The urgent necessity of encouraging and supporting scientific and industrial research has led to the formation of a "Foundation for the Promotion of Scientific and Industrial Research of Japan" which was incorporated in December 1932 with an annual Government grant of 700,000 yen for current expenses.

Lectures for Students in Secondary Schools

WITH the view of stimulating interest in science and its contacts with everyday life among pupils in secondary schools, the British Science Guild has inaugurated a new series of lectures by eminent men of science to pupils from such girls' schools in London The first of the series will be by Mr C C Paterson, director of the Research Laboratories of the General Electric Company, who will lecture on "The Electron Liberated: its Industrial Consequences" The lecture will be given to pupils from schools north of the Thames on Monday, March 25, at 5 0 p m in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, London, W C 2, and will be repeated to the group of schools south of the river on Wednesday, March 27, at the same hour

Memorial to Sir Edgeworth David

IN order to ensure a memorial worthy of Sir Edgeworth David, the geologist and explorer, who died on August 28, 1934, a meeting has been held in Sydney which included representatives from the business, professional, scientific and academic life of the city, and the following resolution was adopted "In view of the great work done by Sir Edgeworth David for the science of geology and in view of the outstanding importance of his teaching, research, and contributions to geological knowledge as the first Professor of Geology in the University of Sydney, the Committee resolves (1) that a fund to be known as the David Memorial Fund be raised, that it be handed over to the University of Sydney, and that the income from it be applied in such manner as the Senate thinks will best aid in the advancement of the science of geology; and (2) that the Senate be requested to associate the name of Sir Edgeworth David permanently with the Chair of Geology" Further information can be obtained from the Honorary Treasurers, David Memorial Fund, Science House, Gloucester Street, Sydney.

Announcements

HIS MAJESTY THE KING has been graciously pleased to accord his patronage to the Institute of Chemistry of Great Britain and Ireland The Institute, which was founded in October 1877, celebrates this year its charter jubilee, having been incorporated by royal charter granted by H M Queen Victoria in June 1885.

THE University of Toronto has awarded the Charles Mickle fellowship for 1935 jointly to Dr. Edward Mellanby and Mrs. May Mellanby. The fellowship is endowed under a bequest by the late Dr W J. Mickle, and is awarded annually "to that member of the medical profession who is considered by the Council of the Faculty of Medicine of the University of Toronto to have done most during the preceding ten years to advance sound knowledge of a practical kind in medical art or science"

MR. H. J. POOLEY, general secretary of the Society of Chemical Industry, who was the first student to go through a course of chemical engineering at a British university - Liverpool 1894-98 - has been awarded the Osborne Reynolds medal for meritorious contribution to the progress of the Institution of Chemical Engineers The medal, which was first awarded in 1928, is in honour of Prof Osborne Reynolds (1842-1912), whose researches on heat transmission and the flow of liquids are extremely important to the chemical engineer

IT is announced that the dates for the May and June soirées of the Royal Society have been altered to Friday, May 3 and Friday, June 14

THE German Röntgen Society has recently had a memorial tablet erected to Röntgen at Pontresina in the Engadine, where for more than forty years he spent his annual holiday

AN exhibition of hygiene will be held in Strasbourg on April 6-22 to demonstrate scientific, administrative, industrial and commercial progress in the field of hygiene and sanitary technique, particularly as regards corporal hygiene, school hygiene, housing, clothing, diet and sport Further information can be obtained from Services Administratifs, Hôtel de Ville, rue Brulée 9, Strasbourg

THE Association of Special Libraries and Information Bureaux (ASLIB) is to hold its twelfth annual conference at St John's College, Cambridge, during the week end beginning Friday, September 20 Particulars may be obtained from the Secretary of the Association, 16 Russell Square, London, W C 1 Sir Richard Gregory has agreed to accept re-nomination as president of the Association for 1935-36

ON the initiative of the Italian Society of Criminal Anthropology and Psychology, a meeting was recently held in Paris, attended by the Minister of Justice, numerous leaders of the French medical and legal professions, members of the French society of criminal prophylaxis and various foreign representatives, to discuss a proposal to found an international society of criminal anthropology and psychology After acceptance of the proposal, it was agreed to hold the first congress of the society in Rome next October

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant secretary to the British Association—The Secretary, British Association, Burlington House, W.1 (March 11) A principal of the Barrow-in-Furness Technical College—The Director of Education, Town Hall, Barrow-in-Furness (March 12) A probationer naturalist (male) on the scientific staff of the Fishery Board for Scotland—The Secretary 101 George Street, Edinburgh, 2 (March 18) A reader in sociology at Bedford College—The Academic Registrar, University of London, S W 7 (April 1) A William Prescott professor of the care of animals in the University of Liverpool—The Registrar (April 23)

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 346.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Laws of Shell-Growth in English Native Oysters (*Ostrea edulis*)

ON investigating recently an economic problem on growth in the native oyster, *Ostrea edulis*, close relations were found between volume and weight of the entire animal, and both mean diameter and mean axis of the shell (mean axis being the mean of the described[1] dimensions of length, breadth—or height zoologically, and width —or thickness) As oysters are measured in wooden tubs (4 'wash' = one 'tub') on the oyster-beds and mean diameter is the simplest criterion of size, volume and mean diameter are the most interesting relations economically Volumes and mean diameters for Essex native oysters from Roach River are given in Fig 1, R^1, and show a close approximation to the relation $y = 0{\cdot}0404\ x^{3\cdot 531}$ where y is volume in c.c. and x = mean diameter in cm The plottings are of samples of 10–40 oysters estimated at 2, 2 or 3, 3, 4, 4 or 5, and 5 years of age, with additional samples of small oysters, for which I am greatly indebted to Mr. Austin Gardner and M Rigoine de Fougerolles Samples of tiny oysters grown in 1934 in the sea were obtained living on a limed tile from France and are plotted, since English spat attached to shell are difficult to detach whole, and any difference between English and French spat is estimated to be non-significant on the scale shown

It is clear that a definite law of growth exists irrespective of rate and notwithstanding the range of individual variation which will be discussed later It can be shown that, for any given increment in average mean diameter, the average increase in volume is successively approximately 11·56 times, 4·19, 2·76, 2·20, 1·90, 1·72, 1·60, 1·52, 1·45, 1·40 and so on · thus from ½ in to 1 in the increase in volume is 11·56 times or 1,056 per cent; from 1 in to 1½ in 4·19 times or 319 per cent; from 1½ in to 2 in. 2·76 times or 176 per cent; 2 in. to 2½ in. 2·20 times or 120 per cent; 2½ in. to 3 in. 1·90 times or 90 per cent. Similarly, the increase in mean diameter from 1 cm to 2 cm. is 11·56 times and from 2 cm. to 3 cm 4·19 times and so on; and from 0·5 cm to 1 cm. 11·56 times and from 1·0 cm. to 1·5 cm 4·18 times and so on

It is known that the rate of growth of the shell varies locally with habitat and from season to season[2] with environmental conditions, and that therefore there is no special size for a given age. Nevertheless, age can be estimated empirically from local knowledge to within one year in a fair proportion of shells. The estimations plotted in Fig. 1, R^1, are subject to these limitations; for example, groups 2–3 and 4–5 were put in intermediate classes; most of the shells showed uniformly good growth.

Experiments in the sea on the growth of Essex native oysters in the first and second year have been made over a long period[3], and one sample has been reared into the fourth year. This sample was taken out of the sea in the summer of 1927 when the fourth year's growth had begun. two of the largest of these are plotted in Fig 1 (*WM*[1]). A few oysters reared

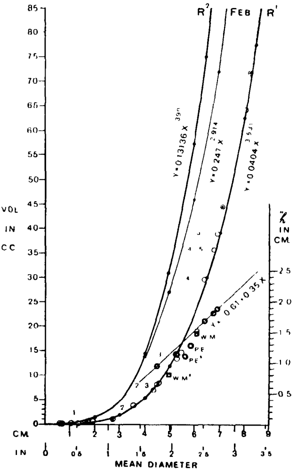

FIG 1 Laws of shell-growth in some habitat races of *O. edulis*.

R^1 relation between volume of the entire living animal and mean diameter of the shell in Roach River, Essex natives. October 1934

R^2: relation between volume and mean axis in the same material as used for R^1 October 1934.

F.E.B approximate relation between volume of the entire living animal and mean axis of the shell (with mean diameter reduced by the amount of new shell shoot). Fal Estuary, East Bank. November 1934.

Samples are shown by open circles of different kinds; individuals by circles with large central dots, and calculated points by dots; the numerals 1, 2, etc., give the estimated age in summers of adjacent samples. *W.M*, *P.E*, experimental samples from West Mersea, and Port Erin ponds.

Slopes and constants of the log-graphs are close approximations and are modifiable for immaturity.

in the Port Erin tanks[3] and examined in the third summer of growth (1934) during the growth period are also plotted in Fig. 1 (*P.E.*[1]). In these two cases new thin shell shoots have rapidly increased the mean diameter without an immediate commensurate increase in volume[4] The samples and experiments illustrate the wide range of variation in annual rate of growth, and indicate that well thought out and long standing experiments in the sea are needed in different localities to obtain satisfactory data correlated with the environmental conditions It is hoped to begin such experiments in the near future

The relation of mean axis lies somewhat closer than mean diameter to volume and offers a better criterion of comparison between different stocks of oysters The difference between certain types of Essex natives and Fal Estuary bank oysters already noticed[4] is given definite expression in the deduced graphs (see Fig. 1, R^2 and *F E B*) for the relation of volume to mean axis, details of which will be published later

The resemblance of the shape of *O edulis* to a segment of a sphere is real, since the 'heights' (*h*) of segments of spheres having the same volume and mean diameter as the major oyster samples noted above give the straight line graph in Fig. 1, within experimental error, when plotted against mean diameter. (Prof L Rosenhead kindly gave me a formula for finding unknown heights from given diameter and volume) The fundamental shape of this oyster is therefore a function of that of a segment of a sphere; for a definite relation also exists between segment heights and observed oyster widths, as will be shown when the subject can be treated more fully at a later date.

J. H. ORTON

University, Liverpool.
Dec 20.

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[1] Orton, J H, Report on a Survey of the Fal Estuary Oyster Beds p 12, Falmouth, 1925
[2] *ibid*, Fig 9, p 22 and p 23
[3] Orton, J H, Parke, M W and Smith, W C, NATURE, 131, 26, 1933
[4] Orton, J H, *J Mar Biol. Assoc*, 15, 367 and 418, 1928

Detection of Nuclear Disintegration in a Photographic Emulsion

IT has been shown recently by Chadwick and Goldhaber[1], and by Fermi and his collaborators[2], that some light nuclei, particularly lithium and boron, are disintegrated by slow neutrons In the case of boron, the mass-energy relations seemed best satisfied by assuming a disintegration into three particles[1] The simplest reaction, namely.

$$B^{10} + n^1 \rightarrow Li^7 + He^4 \quad . \quad . \quad . \quad . \quad . \quad (1)^2$$

should, according to the accepted masses of the particles, release some two million e volts more energy than is observed. Unless the existence of new isotopes, He^5 or Li^6, of improbably low masses, be assumed, no other disintegration into two particles would fit the mass-energy relations.

To decide the type of reaction directly we have made use of the following method. A photographic plate was soaked in a solution of borax and then dried, thus introducing boron into the gelatine. The plate was then exposed for 15 hours to a radon-beryllium neutron source of strength 80 millicuries, enclosed in a thick lead cylinder to reduce the effect of the gamma-rays. Both source and plate were surrounded by paraffin.

One of us (H. J. T.) has worked for some time on the detection of fast particles by the tracks produced in photographic emulsions. By the courtesy of the research staff of Messrs. Ilford, Ltd., new types of plate have been prepared specially suitable for this work, and we have used these special plates in the present experiments

The plate impregnated with borax shows, under a high magnification, numerous short straight tracks, of which the equivalent length in air is 1·1 ± 0 1 cm. There are some 50,000 such tracks per sq cm of the plate A photomicrograph of one of the tracks is reproduced (Fig 1 × 1250) Control experiments with untreated plates show that the tracks cannot reasonably be ascribed to any other cause than the disintegration of boron by slow neutrons

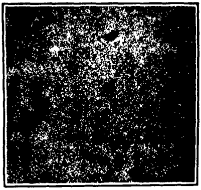

FIG 1

Tracks of this kind cannot be due to a three-particle disintegration, and we must therefore conclude that the disintegration takes place according to reaction (1), which requires that the mass of the B^{10} atom should be 10·011 ± 0 001, the other masses being known to within fairly narrow limits

Note added in proof: In a similar way, by using a salt of lithium, we have obtained tracks which correspond to the reaction

$$Li^6 + n^1 \rightarrow He^4 + H^3 \quad . \quad . \quad . \quad . \quad . \quad (2)^1$$

The length of these tracks represents the sum of the ranges of the two resultant particles, and is found to be 6 9 ± 0 2 cm air.

H J TAYLOR
M GOLDHABER

Cavendish Laboratory,
Cambridge Feb 11.

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[1] NATURE, 135, 65, Jan 12, 1935
[2] Amaldi, D'Agostino, Fermi, Pontecarvo, Rasetti and Segré *Ricerca Scientifica*, VI, vol 1, No 2, Jan 31, 1935.

Directed Diffusion or Canalisation of Slow Neutrons

IT has been shown by Fermi and his collaborators[1] that the efficiency of radioactivation of certain elements by neutron bombardment is greatly increased by surrounding them with water, paraffin or similar hydrogen-containing substances This effect is attributed to multiple collisions between neutrons and protons, similar to those due to the thermal agitation of gas molecules, producing reduction in speed of the neutrons, which facilitates capture by other nuclei

It was pointed out to us by Dr Leo Szilard, who was then working in this laboratory, that this retardation by diffusion should afford a possible method of controlling the direction of propagation of slow neutrons. The mean free path of slow neutrons between successive collisions with protons is considerably less than their range in air. Consequently, it was anticipated that a stream of slow neutrons would diffuse more readily along an air column contained in a tube having walls composed of a substance of high hydrogen content, than through the walls themselves.

We have verified Dr. Szilard's prediction in the following manner. Neutron sources consisting either of about 100 millicuries of radon with beryllium, or of 150 milligrams of radium in tubes surrounded by beryllium, were embedded in paraffin blocks 10 cm. in diameter and 10 cm. high, and placed inside a large cavity in the base of a hollow cylinder of paraffin wax. The walls of the cylinder were 7–10 cm. thick, and its length could be altered by the addition of a number of similar sections of 12 cm. internal diameter. The intensity of the neutron beam at various distances from the source was measured by the radioactivity induced in thin pieces of silver or rhodium or in iodine, the activity of the detectors being measured by a Geiger-Muller counter.

In this way, appreciable radioactivation was obtained at distances exceeding one metre from the source. A right angle bend in the tube reduced the intensity of the neutron beam by about 30 per cent. To obtain the maximum canalising effect, it was found necessary to avoid all gaps in the walls and to close both ends of the canal with wax. A tube of pure graphite gave a smaller but definite canalising effect, but none was observed with a tube of adulterated ebonite.

Fuller details of these experiments will appear in a forthcoming issue of the *British Journal of Radiology*, and other observations will be published independently by Dr. Szilard.

F. L. HOPWOOD.
T. A. CHALMERS.

St. Bartholomew's Hospital Medical College,
London. Feb. 19.

[1] *La Ricerca Scientifica*, V, 2, 7-8, 1934. V, 2, 380, 1934. VI, 1, 2, 1935.

The Absolute Field Constant in the New Field Theory

IN the modification of Maxwell's theory proposed by one of us[1], the notion of an 'absolute field', called b, played an essential part. In the electrostatic case, the universal constant b is simply the upper limit of the field strength, whilst in the general case of an arbitrary field, b sets a limit to the possible values of $\sqrt{(\vec{E}^2-\vec{H}^2)}$, when $\vec{E}$ and $\vec{H}$ are calculated in that Lorentz frame in which the Poynting vector vanishes in the given world-point. (In the exceptional case when there is no such Lorentz frame, that is, if $\vec{E}$ is perpendicular to $\vec{H}$ and $\vec{E}^2 = \vec{H}^2$, there is no limit.) Born and Infeld[2] have calculated b from the experimental values of the charge e and mass m of the electron by equating to mc^2 the total energy of that centrally symmetrical electrostatic solution which has the total charge e. By this procedure b works out to be $9{\cdot}18 \times 10^{15}$ E.S.U.

We now believe that this determination may be wrong, notably too high, because the spin had been neglected. Since the solution for the spinning electron cannot yet be calculated, we must content ourselves with giving a rough estimate. Let μ be the magnetic moment of the spin and r' the *new* radius of the electron (to be calculated here) and let us try tentatively to account for the observed mass m by the energy of the spin only (neglecting the electrostatic energy). The following statement will then be correct as to order of magnitude:

$$\frac{1}{2}\frac{\mu^2}{r'^3} = mc^2.$$

We can assume that μ is Bohr's magneton

$$\mu = \frac{eh}{4\pi mc} = \frac{e}{2}\cdot\frac{e^2}{mc^2}\cdot\frac{hc}{2\pi e^2} = \frac{er_0}{2\alpha},$$

where

$$\alpha = \frac{hc}{2\pi e^2} = \frac{1}{137{\cdot}2},$$

the fine-structure constant, and $r_0 = e^2/mc^2$, the quantity usually called the radius of the electron; it is connected with the electronic radius r_{el} of the new field theory by the equation

$$r_{el} = 1{\cdot}236 r_0.$$

From our first equation we find now

$$r' = \frac{r_0}{2\alpha^{2/3}} = \frac{r_{el}}{2{\cdot}472 \times \alpha^{2/3}} = 11 r_{el}.$$

Since r' is considerably larger than r_{el}, the electrostatic energy in the new model will be a small fraction of mc^2, and we are justified in neglecting it for our rough estimate.

Again, the field 'in the interior' of the magneton may safely be equated to the absolute field b, which fact, as to the order of magnitude, will be expressed by

$$b = \frac{\mu}{r'^3} = \frac{2mc^2}{\mu} = 4\alpha\,.\,\frac{e}{r_0}\,.\,\frac{mc^2}{e^2} = 4\alpha\,.\,\frac{e}{r_0^2}.$$

This is to be compared with the value, say b_{el}, formerly calculated from the electrostatic energy:

$$b_{el} = \frac{e}{r_{el}^2} = \frac{e}{(1{\cdot}236 r_0)^2}.$$

We have

$$b = 4(1{\cdot}236)^2\;\alpha\;b_{el} = \frac{b_{el}}{22{\cdot}5}.$$

If the estimates are not too rough, the new point of view increases the radius of the electron by a factor of about 10, and decreases the limiting field to about the twentieth part.

MAX BORN.
Cambridge.

ERWIN SCHRÖDINGER.
Oxford. Jan. 28.

[1] M. Born, NATURE, 132, 282; 1933.
[2] M. Born and L. Infeld, *Proc. Roy. Soc.*, A, 144, 425; 1934.

The Hypothesis of Continental Drift

THE late Dr. A. Wegener claimed the advantage for his hypothesis of 'continental drift' that it could be tested by making repeated astronomical observations of the positions of land stations; for drifts at the rates of only a few feet a year would suffice to carry the land masses far within the span of geological time. Few geologists would in respect to this problem deny the applicability of the dictum that 'the present is the key to the past'; the question is whether precision determinations of 'position' will give measurable results within a reasonable time.

In 1932 Herr Hans Jelstrup determined the longitude of Sabine I, East Greenland, and comparing his value with that of Börgen and Copeland's (1870) he finds a westerly drift of 615 metres. Owing to uncertainties inherent in the methods used in 1870, this figure is unreliable, but Herr Jelstrup concludes that at least 250 metres of the apparent drift is a real one, and he expresses the hope that it will be possible to repeat his observations in, say, 1942 to establish the fact of drift beyond all possible *doubt*[1]

Herr Jelstrup's results would seem to warrant the initiation of an investigation of the matter as a world problem by fixing now the positions of a network of stations, so that by future observations the reality of 'continental drift' may be settled one way or the other in the lifetimes of at least the younger of us The stations must be chosen with due regard to geological situation To examine 'continental drift' we shall want them on the great 'shields'—especially on extensive 'crystalline massifs', the so-called 'stable blocks' That large horizontal displacements have taken place in the 'mobile belts' of the crust is known and it would be valuable to have stations on such belts which show activity at the present day, for example, the East-Indian island arcs, so that the movements of the 'stable blocks' may be related to the crumplings of the 'mobile belts' Such results cannot fail to throw light on the mechanism of mountain building, and there is good reason to believe that it will now be possible to raise the study of crustal movements to a science by obtaining quantitative data

The time has come for some international body to take up the matter (1) to inquire what stations, such as the great observatories, have been determined with sufficient accuracy to be of use, (2) to consider what further stations shall be established, and (3) to organise periodic redeterminations every five or ten years in the future

L HAWKES

Bedford College,
Regent's Park, N W 1
Feb 1

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[1] *Naturen*, No 10, p 300, 1934

Action of Thyroid Extract on the Respiration of Tissues of Invertebrates

THE respiration of fresh tissues (whole and macerated), and of dried and powdered tissues of various invertebrates with and without the addition of thyroid extract, was measured in the Barcroft Warburg apparatus (in Ringer solution, sea-water, normal saline or water, according to the tissue)

It was found that in the case of eggs of insects—mono-voltinic *Bombyx mori* during æstivation and incubation (1st and 3rd stages of egg development)—thyroid extract caused an increase of oxygen consumption up to 23 per cent; on hibernating eggs the effect of thyroid extract was even more marked, and oxygen consumption was increased up to 3,700 per cent The experiments were carried out at temperatures of 17°–37° C With whole and various portions of the silk-glands of *Bombyx mori*, oxygen consumption was increased up to 15 per cent.

Echinoderma An increase up to 300 per cent was noted with unfertilised eggs and with ovaries of *Spherocinus granularis*.

Crustacea. With fertilised eggs in all stages of development of *Carcinus mænas*, *Eupagurus prideauxii*, *Portunus corrugatus* and *Portunus holsatus* an increase up to 300 per cent was noted

Mollusca With fertilised eggs of *Aplysia limacina*, an increase up to 220 per cent was noted

Tunicata With the ovary of *Ciona intestinalis* an increase of oxygen consumption up to 360 per cent was noted

In every case the action of the thyroid extract was *identical on the uninjured and freshly macerated* tissues

The action of the thyroid extract was even more marked on suspensions of tissues which had been dried and powdered, for example, increase of oxygen consumption was noted up to

5,000 per cent with powdered eggs of *Bombyx mori*,
3,000 ,, ,, ,, , silk glands of *Bombyx mori*,
9,300 ,, ,, ,, ,, ovary of Echinoderma,
4,000 ,, ,, ,, ,, eggs of Crustacea,
2,700 ,, ,, ,, ,, eggs of Mollusca,
30,000 ,, ,, ,, ,, ovary of Tunicata

The influence of thyroid extract on oxygen consumption is almost instantaneous and lasts up to 20 minutes In the case of suspensions of powdered tissues which have been standing for months (eggs and silk glands of *Bombyx mori*) and show almost zero oxygen consumption, the addition of thyroid extract causes an almost immediate restoration of oxygen consumption

Solutions of potassium cyanide did not diminish the action of thyroid extract on suspensions of dried and powdered eggs of *Bombyx mori*, the cyanide alone, in the absence of thyroid extract, was found to increase the oxygen consumption of this suspension

All the experiments are made with the thyroid extract 'Elyteran' (Bayer) Synthetic thyroxin was found to have no effect at all on oxygen consumption Full details will be published elsewhere

RIVKA ASHBEL

Department of Parasitology,
Hebrew University,
Jerusalem,
and
Stazione Zoologica,
Naples

Anæsthesia Produced Electrically

IN his letter entitled "Testing for Unconsciousness after an Electric Shock", in NATURE of January 19, Capt C W Hume expresses the opinion that the electric stunning of animals is based on dogmatic assertions He need not fear that research in this matter will not be welcomed by all concerned, or that any inquiry, based on actual investigation, will be stifled It is, however, only a matter of time before such research confirms the opinions expressed by eminent physiologists in favour of electric anæsthesia for animals

The points raised by Capt Hume do not help to clarify matters; in fact, argument from such premises is liable to confuse the issue They may be commented on as follows.

(1) The subject referred to is a human being Animals are very much more susceptible to electric shock than humans as shown by the extraordinary cases of animal electrocution on record There is no evidence of the existence of a 'nightmare state' in the case of animals

(2) The interrupted D C used by Regensburger and Hertz is weak compared with the sinusoidal A C used in electric stunning if maximum values be considered A 10 per cent interrupted D C giving a meter reading of 31 milliamp is really a current of 310 milliamp 0 5 amp R M S A C represents a maximum current of 710 milliamp It is beyond doubt that the stunning effect depends on the strength of the current and not the length of time for which it is applied The A C is therefore twice as effective as the intermittent D C used by Regensburger and four times that used by Hertz

(3) The current strength applied in electric stunning is considerably above that required to produce immobility during application only It has been noted that, with animals, a low current just sufficient to paralyse produces rigidity A higher current invariably produces relaxation, and it is only when this state is reached that pain unconsciousness is assured

(4) and (5) It must be definitely stated that experiments on human beings do not prove anything with regard to the effect of electric current on animals such as sheep and pigs, and cannot logically be cited in this connexion Further, the fact that Hertz's experiments were carried out on incurable invalids means that the results are not necessarily valid for healthy subjects In my experience, the animals that are difficult to stun electrically are those that are unhealthy In particular, a pig which would not stun properly was found to be tuberculous

(6) The 'nightmare state', whether it be produced or not in animals as in human beings, implies insensibility to pain In electrical accidents, severe burning has been felt only as a 'stinging sensation'

(7) If muscular contraction persists in an animal for more than a second, either the current is too low, the electrodes improperly applied or the animal unhealthy In actual practice, almost all animals under proper conditions of electric stunning relax instantly and remain relaxed until normal post mortem reflex action commences

F. DE LA C CHARD

Electrical Engineering Department,
University of Bristol

Moulting and Replacement of Feathers

MY attention has been directed to a letter in NATURE of January 26 from Miss Anne Hosker In this letter, Miss Hosker states that I am wrong as regards the statement made in my paper[1], namely, that "As compared with other bird-groups the condition (of moulting in the penguin), as far as I am aware, is absolutely unique"

In the specimen on which the statement was founded (which can still be seen in the British Museum, Natural History), almost fully grown new feathers can be exposed, on dissection, occupying the highly specialised feather follicles embedded in the subcutaneous tissue (cf. loc. cit text-figures 6 and 7) They can be cut out of these follicles, dried and demonstrated to be nearly as large as the old feathers about to be shed, and of course more perfect, while, as I stated, the tip of the new feather, if still in continuity with the old, is thrust through the lower umbilicus and pushes the old feather before it, so that the latter may be as much as nearly a quarter of an inch distant from the outer surface of the skin In other words, *the new feather is already fully formed and ready to come through before the old feather is shed*

If this can be proved not to be a unique phenomenon in the avian world, I think most ornithologists will be greatly surprised, but after reading Miss Hosker's letter I would beg leave to make the suggestion that perhaps she and I have been writing about two different things Miss Hosker seems to have been dealing with the well-known mode of development of the series of prepennal and pennal feathers as they first emerge from the chick On the other hand, I was dealing in my paper with the wonderful adaptation to be observed in the penguin when moulting, an adaptation the object of which is obviously to lose as little time as possible, since until the penguin has completed its moult it cannot enter the water and so has to starve

PERCY R LOWE

45 Cadogan Place,
S W 1

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[1] *Proc Zool Soc*, p 499 1933

Molecular Spectrum of Cadmium Vapour

PROF ROBERTSON'S observation[1] of a maximum at 2212 A in the spectrum of an arc between cadmium electrodes which is much more intense than the cadmium band at 2125 is very interesting This observation is surprising in view of the fact that no maximum at 2212 was observed by Cram[2] in fluorescence or Tesla discharge, while the 2125 band was easily observed both in fluorescence and discharge The condensed copper spark giving more intensity near 2212 than 2125 when used as source for fluorescence excited 2125 with no emission maximum at 2212 These two bands have nearly the same intensity in absorption The failure of an emission maximum at 2212 to appear along with the 2125 band of cadmium in fluorescence and discharge in pure cadmium vapour shows that the 2212 maximum is likely to be due to an impurity The opportunity for observing spectra due to impurities (such as CdO, CdH, etc) is always much greater in the arc in air than in a quartz tube containing only pure cadmium

The earlier reproductions of the spectra of electrodeless discharges through cadmium vapour given by Robertson show a maximum at 2212 at low pressure but no 2212 maximum at high pressure This favours the view that the 2212 maximum comes from an impurity the relative importance of which in the vapour is less at high cadmium pressures. Cram failed to observe an emission maximum at 2212 in cadmium vapour at any pressure

If we consider the corresponding bands of zinc and mercury, the following similarities are observable. Let B represent the bands Zn 2060, Cd 2212, Hg 1808 and C the bands Zn 2000, Cd 2125, Hg 1692. In absorption, the intensity of B is greater than or equal to that of C. In emission from a Tesla discharge through the vapour at pressures of 10-40 mm, C is much more intense than B. In most cases B was not observed at all In contrast, Robertson observed in the cadmium arc spectrum an emission maximum corresponding to B much more intense than C. This would indicate either that conditions in the cadmium arc were especially favourable to emission of B or that the 2212 emission maximum was due to an impurity

Since learning of Robertson's results, we have photographed the spectra of arcs with electrodes of carbon, and zinc or cadmium, with the carbon positive. The spectra are shown in Fig 1 The cadmium arc shows the emission maximum at 2212 but the zinc arc does not show a corresponding maximum at 2060 This failure of 2060 is probably not due to insufficient vapour pressure of zinc in the arc since the reversals of the zinc and cadmium resonance lines are approximately equal in width, and the intensity of *B* and *C* relative to the resonance lines in absorption is about the same for zinc and cadmium This observation shows that conditions in the arc are not favourable for emission of band *B* of zinc although they still may be for *B* of cadmium This, however, again indicates that the source of the emission maximum at 2212 in the cadmium arc is an impurity.

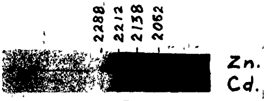

Fig 1

J G Winans
S W Cram

University of Wisconsin
Dec 22, 1934

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[1] J K Robertson, *Phil Mag* 14, 795 , 1932 See also Nature, **135** 308, Feb 23, 1935
[2] S W Cram, *Phys Rev* , 46, 205 , 1934

Deamination in Virus-infected Plants

Boncquet[1] noticed increased production of ammonia in curly top of beets and in tobacco mosaic and traced it to the presence of denitrifying organisms occurring in association with the diseased plants Jodidi and co-workers observed similar increase in spinach blight[2], spinach mosaic[3] and cabbage mosaic[4] and attributed it to denitrification since there was diminution in total nitrogen The latter authors indicated the possible formation of hydroxy acids, but did not study the related acid metabolism

In the course of an inquiry on the mechanism of increased formation of ammonia in spiked sandal, I noted distinct increase in hydroxy acids, especially malic, in the earlier stages. In the more advanced condition, succinic acid was found to be present in the diseased tissues while it was entirely absent from the healthy ones These observations having suggested the presence of an active deaminase in infected plants, a series of quantitative studies were carried out, adopting the method of Kisch[5]

The following were some of the results obtained

Deaminase activity of healthy and spiked sandal

Time in hours	Ammonia (in c c *N*/50) produced by 1 gm of leaf powder		Carbon dioxide (in c c *N*/50) produced by 1 gm of leaf powder	
	Healthy	Spiked	Healthy	Spiked
1	0 2	0 8	0 8	1 4
4	0 5	2 7	2 1	4 7
8	0 8	5 8	3 4	9 6
14	1 2	9 2	5 1	16 8

It is clear from the above that the increased production of ammonia is due to greater oxidative deamination in the diseased tissues Further work on these and other aspects is in progress and will be published shortly in the *Journal of the Indian Institute of Science*

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Dec 22, 1934

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[1] *J Amer Chem Soc* , 28, 2572 , 1910
[2] *J Agric Res* , 15, 385 , 1918
[3] *J Amer Chem Soc* , 42, 1061 , 1920
[4] *ibid* , 42, 1883 , 1920
[5] *Fermentforschung*, 13, 433 , 1932

Interconvertibility of Glucose and Fructose in Plant Tissue

In a recent paper from this laboratory[1] it was shown that sucrose is formed both from glucose and from fructose when starch-depleted leaves of red clover or wheat plants are placed in 10 per cent solutions of these hexose sugars in the dark This result was explained by assuming that glucose and fructose are transformed into each other in plant tissue

Continued research has now confirmed the above assumption The experiments were made with several plant species, both grasses and legumes The plants were first kept in the dark for forty-eight hours to deprive them of starch, whereupon they were placed in 10 per cent sugar solutions so that the ends of the stems were immersed while the leaves did not come into direct contact with the liquid After a further twenty-four hours in the dark the leaves were cut off from the stems and dried and analysed separately The drying was carried out *in vacuo* at 100°.

The results show that glucose and fructose are indeed easily converted into each other in plant tissue The transformation takes place already in the stems, which is also the seat of sucrose synthesis These reactions are not affected by an addition of 10 per cent toluene to the sugar solutions, and are only slightly retarded by a 0 05 molar potassium cyanide solution There was evidence that in leaves part of the glucose disappears, possibly as a result of respiration Under the conditions of the experiment, the synthesis of starch was very slight or nil. The stalks of horse beans were found to contain much more invertase than the leaves

The following experiment with horse beans will illustrate the quantitative proportions in question. 20 plants were used for each determination All values are computed on a 'residual-dry weight' basis.

	Dry matter Per cent	Total soluble sugars	Glucose	Fructose	Sucrose	Insoluble sugars
N leaves	9 05	7 35	0 7	4 35	0	4 3
N stems	6 0	7 1	0 7	4 6	0	10 25
D leaves	7 75	3 9	0	2 9	0	5 6
D stems	5 55	1 9	0	1 9	0	10 85
G leaves	11 65	17 3	6 2	3 6	5 1	7 0
G stems	8 0	26 25	12 2	7 55	5 15	11 2
F leaves	13 3	17 2	2 95	7 05	6 5	5 3
F stems	8 1	29 15	8 7	14 8	7 25	10 6

(*N* = normal plants, *D* = plants kept in the dark for forty eight hours, *G* = plants kept in 10 per cent glucose solution for a further twenty-four hours, and *F* = plants kept in 10 per cent fructose solution for twenty-four hours)

M Nurmia (Nordlund)

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Jan 4

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[1] Virtanen, A I , and Nordlund, M , *Biochem J* , 28, 1729 , 1934

Spectrum of Nova Herculis, 1934

IN many respects the most recent nova is following the usual course in its spectral changes The present spectrum is a medley of bright bands and of absorption lines the bright hydrogen bands are accompanied by a number of absorption components on the side of shorter wave-length, while corresponding to each component and with the same Doppler displacement are a number of absorption lines due to atoms of Fe+, Ti+, Cr+, Ca+, etc

The chief feature of interest in the spectrum now is the emergence of several bright forbidden lines of O I, first weakly visible in the spectrum of December 27, 1934 They are increasing in brightness and now stand out from the rest of the spectrum, conspicuous both by their strength and by the absence of accompanying absorptions They are the exact analogues in the spectrum of O I of three well-known lines in the spectra of nebulæ and novæ, which are forbidden lines of O III The first of the three lines of O I has been identified with the principal auroral line. The other two lines of O I have been observed in nebulæ also[1] but have not previously been found in novæ The two sets of lines are

O I		O III	
5577	${}^2p\,{}^1D_2 - {}^2p\,{}^1S_0$	4363	$s^2p^2\,{}^1D_2 - s^2p^2\,{}^1S_0$
6300	${}^2p\,{}^3P_2 - {}^2p\,{}^1D_2$	5007	$s^2p^2\,{}^3P_2 - s^2p^2\,{}^1D_2$
6364	${}^2p\,{}^3P_2 - {}^2p\,{}^1D_2$	4959	$s^2p^2\,{}^3P_1 - s^2p^2\,{}^1D_2$

A BEER
F J M. STRATTON

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Feb 21

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[1] Bowen, *Astrophys J*, 81, 12, 1935

Points from Foregoing Letters

A DEFINITE relation is found by Prof J H. Orton between the mean diameter, or the mean axis, of the English native oyster and the volume of the entire animal; this relation is similar to that between the diameter, or thickness, and volume of a segment of a sphere Prof Orton supplies graphs showing these relations in oysters from several localities He indicates upon the graphs the age of the oysters, known in a few cases from tank experiments and estimated empirically in the remaining instances from local knowledge Prof Orton believes that the probable increase of the stock on an oyster-bed in a given time could be predicted, given sufficient observations

Photographic plates impregnated with borax register the action of neutrons (from a radon-beryllium source) upon the boron atoms in the borax Messrs H J Taylor and M Goldhaber have found some 50,000 microscopic tracks produced per square centimetre, and from the length of these tracks they confirm the previous deduction that boron atoms are transmuted to lithium plus helium Similar experiments show that lithium acted upon by neutrons gives helium plus hydrogen atoms of mass 3 These nuclear reactions release several million volts of energy

Neutrons, the most efficient agents in atomic transmutations, can be directed or canalised along tubes having walls made of a substance of high hydrogen content. This prediction by Dr Szilard has been confirmed by Prof. F. L Hopwood and Mr T. A. Chalmers, who used hollow cylinders of paraffin wax A graphite tube also gave a small canalisation effect, but none was observed with impure ebonite

If the spin of the electrons be taken into consideration, the value of the 'absolute field constant' calculated by Born and Infeld ($9{\cdot}18 \times 10^{15}$ E.S U.) is considerably diminished Drs. Max Born and E. Schrödinger estimate roughly that its value is decreased about twenty-fold, while the radius of the electron is increased ten-fold.

From a comparison of determinations of longitude in 1870 and 1932, Sabine I., East Greenland, seems to have drifted westwards several hundred metres. Dr L Hawkes advocates the establishment, in specially selected parts of the world, of stations specially fitted to determine by astronomical observations the occurrence of lateral drift He points out that the results would throw light on the mechanism of mountain building; it should also prove or disprove Wegener's theory, which assumes that the continents are the broken pieces of a sheet of lighter and more acid rock 'floating' upon a denser and more basic rock, and that they are still moving laterally

A large increase in respiration by organs of various invertebrate animals, under the action of thyroid extract, is reported by Dr Rivka Ashbel Comparative figures are given for the eggs of silkworms, crabs and molluscs, and the ovary of the sea-urchins and sea-squirts

In NATURE of February 23, Prof Robertson supported his earlier observations that cadmium vapour emits ultra-violet light of wave-lengths 2212 A by pointing out that the cadmium arc emits such light, and that the zinc arc emits the corresponding light of wave-lengths 2060 A Prof. J. G Winans and Mr. S W Cram now write that the zinc arc shows no corresponding *maximum* at 2060 A, and maintain that the 2212 band observed by Robertson is probably due to an impurity such as cadmium oxide or hydride

Mr A V V. Iyengar has observed in 'spiked' sandal an increase not only in ammonia but also in hydroxy-acids (malic and succinic) He suggests that these are formed by an active deaminase (an enzyme capable of replacing the $-NH_2$ group of amino-acids by the $-OH$ group of water, leading to the formation of hydroxy-acids and ammonia). The same deaminase may be responsible for the increased production of ammonia in tobacco mosaic, spinach blight and mosaic, etc

It has been found that ordinary cane-sugar (sucrose) is formed by starch-free plant leaves from either glucose or fructose alone, although its molecule is made up of both these simpler sugars. M. Nurmia now reports further experiments showing that plant tissues have the property of changing glucose into fructose.

Research Items

Early Man in China. Further researches and discoveries at Choukoutien, the site of discovery of Peking man, are described in three recent communications to the Geological Society of China. Messrs. Ralph W Chaney and Lyman H Daugherty deal with the occurrence of *Cercis* in association with the remains of *Sinanthropus* (Bull. 12, No. 3). Fragments of charred wood pointing to the use of fire by Peking man have been identified as a new species of *Cercis*, a member of the family of Leguminosæ. In honour of the late Davidson Black it is named specifically *Blackii*, but it is sufficiently akin to *C. chinensis*, common in Chili Province, to suggest the probability that the climate in Peking man's day was much as it is now P Teilhard de Chardin and Dr. W C Pei report on discoveries in 1933–34 at Choukoutien (Bull 13, No 3) which, while not altering previous conclusions, add distinctness to precedent views on the stratigraphy and physiography of late Cenozoic times in north China It is now apparent that the Lower Pleistocene, unknown for so long, is one of the most important Cenozoic formations in north China New localities in the form of pockets have been opened up which make it possible to distinguish five, or even six, stages, instead of the three sedimentary units and the single fossiliferous horizon (*Sinanthropus* beds) previously differentiated. A preliminary report on the late palæolithic cave is presented by Dr W C Pei (Bull. 13, No 4) in which the archæological and palæontological finds are described. Five cultural layers were found Three human skulls and a large series of other human bones were discovered and among the artefacts 28 perforated teeth (canines) of fox or badger, which by their juxtaposition suggest the use of teeth as a necklace. As possibly younger than the remains of southern Ordos and older than Hailar, a tentative dating as equivalent to Magdalenian man in Europe is suggested.

Beehive Graves in the Sudan and Sinai. Mr. G. W Murray describes and figures in *Man* of February six beehive tombs, closely resembling the *nawamis* of Sinai or the *rijjum* of Arabia, which he discovered in 1926 in the neighbourhood of the fishing village of Halaib on the Red Sea coast. Superstructures had been erected over the original interment by corbelling until a beehive of three metres internal diameter at base and 1·7 m. high had been formed with an aperture in the roof large enough to admit the passage of a man. Outside this a dry stone tumulus six metres in diameter had been piled up rather untidily. The Sinai *nawamis* differ from the Halaib graves by having a neatly built retaining wall around them. Two graves were examined and in each at about 20 cm depth very much decomposed bones covered with stones were discovered. The only objects found with them were two copper rings They appeared to be pre-Islamic, but of no very great antiquity. They recall the more elaborate graves described by Schweinfurth from Gebel Maman. Sinaitic *nawamis* excavated by Currelly were found to contain shell ornaments and flint arrow-heads belonging to a primitive race, but not necessarily very early in date. Corbelling in mud brick occurs at a very early date in Egyptian tombs. Dr. Reisner, in a private letter which is quoted, refers to Second Dynasty examples and says that he now assigns the use of rude brick corbelling to the last king of Dynasty I Therefore the practice of corbelling seems to have originated in mud-brick in the Nile Valley about the time of the First Dynasty, to have been copied in rubble masonry by the inhabitants of the desert, and to have spread north-eastward into Sinai and Northern Arabia and south eastward into the Sudan and Eritræa, where it is not yet quite extinguished by the Moslem type of burial

Influence of Light upon Goatsucker's Song Gilbert White shared the general impression that the song of the goatsucker begins "exactly at the close of day", but S E Ashmore's observations in Surrey and Glamorgan carried on during three summers, show that there is a considerable amount of variation (*British Birds*, February, p. 259, 1935) In the course of the day, there are generally two spells of song, one commencing after sunset, the other before sun rise The former began 18–101 minutes after sunset, the latter between 123 minutes and 27 minutes before sunrise, but the average times respectively are about 35 minutes and 50 minutes It would seem that light intensity is one factor in determining the song, for the presence of bright moonlight delayed the commencement of the evening song, though it is not so easy to understand why it should have hastened the commencement of the morning song to the extent of more than half an hour before sunrise Another problem lies in the seasonal variation of the periods, which are longer in mid July than in June or August, although light conditions are not then at their highest The author hazards the suggestion that there may be a "connexion with the hour at which are found flying the moths and other creatures which form the bird's food"

Deep-Sea Fishes and a New Trawl Mr Eide Parr ("Report on Experimental Use of a Triangular Trawl for Bathypelagic Collecting with an Account of the Fishes obtained and a Revision of the Family Cetomimidae" *Bull. Bingham Oceanographic Coll*, 4, 1934 Contribution No 35, Woods Hole Oceanographic Institution) describes a trawl which was successfully used during the first Caribbean cruise of the *Atlantis* sponsored jointly by the Woods Hole Oceanographic Institution and Yale University The large triangular trawl, 50 ft long each side of the opening and with three otter boards, was provided by the Bingham Oceanographic Foundation of Yale University Although difficulties in equipment and arrangements were great, one haul was extremely successful, showing that with certain alterations, easily made on land, this trawl should be a valuable addition in deep-sea collecting to supplement the results obtained by the smaller nets Many large fish are caught, but not so many small specimens, owing to the coarser mesh. The one successful haul yielded a total of 47 species of fish and 491 individuals, 373 of which belonged to the genus *Cyclothone* The author, having examined a large number of samples from the east central Atlantic, concludes that there are only three species of this genus in the area studied—*C. braueri*, *C pallida* and *C microdon*. Several new species are described and a new sub-family and genus. Among the new species is a male *Borophryne*, agreeing in all essentials with *B. apogon* of Regan and Trewavas, but differing in the number of rostral spines and in other minor points As the author states, "it is thus for the first time possible to introduce a new Ceratoid species referred to its proper genus on the basis of a still unattached male only"

Silicoflagellates and Tintinnids of the Great Barrier Reef. Dr S M. Marshall (Great Barrier Reef Expedition 1928-29 Scientific Reports British Museum (Natural History) 4, No. 15, 1934) shows that silicoflagellates are rare in the material available since their small size enables them to pass through the meshes of the finest net By centrifuging the water samples it is found that they were present in small numbers, but show no seasonal variation. The Tintinnoinea were captured in the tow nettings taken with the international fine silk net described by Russell and Colman (2, No 2, 1931) They fall into two groups, those adapted to neritic conditions, and those of oceanic habitat which are restricted to water of relatively high salinity Neritic species are common throughout the year, but especially in March Oceanic species are rarer and occur mainly in August and September from the weekly stations when the salinity inside the barrier was more than 35 per cent Fifty-six species are recorded, twenty-two being cosmopolitan and known from the Atlantic, Pacific and Indian Oceans, sometimes from temperate and even arctic regions Nine species are restricted to warm seas Results from stations on or near the outer reefs suggest that there is a rich tintinnid fauna in the ocean waters outside, of which only some species can live permanently within the barrier Three species are new to science Several forms hitherto only known from the eastern tropical Pacific are now recorded from the western Pacific also

Vegetative Propagation at Edinburgh. For a long time horticulturists have regarded the Edinburgh Botanic Gardens as the place to which to turn for advice and help in matters of plant propagation This has been largely due to the general willingness of the staff to help, but also to the great interest of the late L B Stewart in the problem of vegetative propagation Dr. R J D Graham, who was closely associated with his work, has now stated briefly some of the main conclusions reached by Stewart during his long struggle with the practical problems associated with vegetative propagation (*Trans Proc Bot Soc Edin*, 31, Part 3, 1934) One difficulty is to know when to make the cuttings A general guide is to take the cutting when the season's growth is completed, when reserve foods for next season's growth are being accumulated and when at the same time vigorous cells capable of wound protection are still present Stewart had cuttings taken of many plants every month, and from these data a list is now published by Dr. R J D Graham showing in what months successful (more than ninety per cent) propagation was obtained.

Potato Diseases in Great Britain. The Ministry of Agriculture and Fisheries has recently issued a new portfolio of "Leaflets on Diseases of Potatoes" as No 3 of its series of collected leaflets (London: H.M. Stationery Office, pp 45, 1*s* 6*d* 1934) This loose-leaflet volume replaces No 3 of the older sectional volumes, "Cultivation and Diseases of Potatoes" Three leaflets on potato-growing and the selection of seed tubers are omitted, as the subject-matter is to be expanded into a new bulletin Six of the original leaflets have recently been revised, and issued as advisory leaflets, in which form they are included in the new portfolio They deal with common scab, the Colorado beetle, powdery scab, black-leg, mosaic and virus diseases, and dry rot Advisory leaflet No 71, on the Colorado beetle, is enriched with a new coloured plate, while there are more half-tone illustrations than formerly A seventeen-page insert has been printed specially for the new collection, and briefly describes nine miscellaneous diseases, namely, skin spot, spraing, black scurf and stem canker, violet root-rot, white root-rot, pink rot, watery wound rot, *Verticillium* wilt, and silver scurf. Potato blight, wart, *Sclerotinia* rot and leaf-roll diseases, are adequately described by the inclusion of four older leaflets

Distribution of Earthquakes. A new map by Capt. N H Heck of the distribution of earthquakes throughout the world is published in the *Geographical Review* of January 1935 It is based mainly on the location of epicentres instrumentally determined during the period 1899-1933 To these have been added epicentres of major earthquakes of historical record especially in China, Syria and the Lesser Antilles The map shows clearly two great belts of activity Of these, the more striking is the Mediterranean-Pacific belt, which appears to girdle the earth via the Mediterranean, southern Asia, the north Pacific and West Indies, with main branches southward via the Malay Archipelago and New Guinea to New Zealand and from the West Indies into South America The second belt is that of the mid Atlantic, and this is entirely oceanic and is marked by few major shocks, but of course there is less scope in this belt for instrumental records It is noticeable that practically all the great ocean deeps are within the belts and all the largest rifts on the land surface are within the great belt or its branches There would appear to be no belt crossing the Pacific Ocean, the branch to Easter Island being linked to South America In the South Atlantic, a detached area around the South Sandwich group may prove to be an extension of the mid Atlantic belt

Overhead Irrigation Investigations into the methods and value of overhead or spray irrigation in Australia have been made at the Commonwealth Research Station at Griffith, New South Wales, and some conclusions are published in Pamphlet No 50 of the Council for Scientific and Industrial Research, Melbourne ("The Design of Overhead Irrigation Systems", E S. West and A Howard) The system depends on the distribution of water under pressure from orifices in lateral pipes branching from the mains These laterals are 1-in pipes placed on the ground They can easily be moved from place to place or rotated to ensure complete irrigation The advantages of the system compared with surface methods are the greater control over the quantity and distribution of the water, the absence of water-logging which may occur near irrigation trenches, the lack of need of ditches and levees with a consequent saving of ground and the added possibility of irrigating at will an area not previously prepared, and lastly a great saving in labour There are, however, some disadvantages in the system, including the initial cost, depreciation of plant and the cost of pumping the water. The authors believe that the spray system is cheaper and more advantageous than surface irrigation on undulating land with light soils, and that the converse is true on heavy flat land.

Flow of Colloidal Systems. Dr A. S C Lawrence (*Proc. Roy Soc*, A, Jan. 1) has examined the flow of colloidal liquids, which do not in general behave as simple viscous liquids. The flow was investigated by suddenly changing the flow through a glass tube from colourless solution to solution containing a dye, and photographing the advancing boundary of colour. This boundary is parabolic for ordinary viscous liquids The colloidal systems fall into two classes. in one the resistance is small at the wall of the tube, rises rapidly to a maximum and falls off again to the centre of the tube, in the other, the 'gelating' class, the resistance to flow increases as the axis of the tube is approached Some of the colloidal solutions show very marked elastic properties The anomalous flow is interpreted as due to the mutual interference of large, non-isodimensional (that is, elongated) micelles

Absolute Measurement of X-Rays with a Geiger Counter G L. Locher and D P Le Galley (*Phys Rev*, Dec 15, 1934) have applied the Geiger-Muller counting tube to the absolute measurement of X-ray intensities A narrow beam of X-rays is passed through a counter in such a way that only electrons liberated in the gas of the counter are counted Using krypton at 6·3 cm pressure and zirconium fluorescent *K*-radiation, the absorption of the rays in the gas column is known to be 3 75 per cent, and since the number of electrons corresponding to this absorption is counted, the number of quanta in the beam may be deduced The scattering of the beam may be neglected compared with the fluorescent absorption The beam calibrated in this way was used to obtain the sensitiveness of Eastman X-ray film The minimum visible blackening was obtained with $7 \cdot 2 \times 10^6$ quanta per sq. cm A curve connecting the blackening of the film with the incident quanta is published

Action of Alternating Magnetic Fields upon Ferromagnetic Particles. About twelve years ago, W. M. Mordey described experiments on the action of single and multi-phase alternating magnetic fields on ferromagnetic particles (see *Proc Phys Soc*, **40**, 338; 1928). The phenomena observed suggested that under certain conditions there was a repulsion of the particles from strong to weak field regions. Thus when the particles were strewn on a surface above a series of vertical magnets excited alternately by two-phase current, they moved in the direction opposite to that of the movement of the successive alternate north and south poles to which the arrangement corresponds. No satisfactory interpretation of the phenomena was given Further experiments have been made by H Stafford Hatfield (*Proc Phys Soc*, **46**, 604; 1934), using particles of iron, steel, magnetite and pyrrhotite No anomalous repulsive action was observed when the particles were attached by adhesive to one arm of a torsion balance, or when the particles were allowed to fall freely through the fields. The essential factors involved may be appreciated by considering the effect on a magnetised particle resting on a surface due to a moving vertical magnet, or series of magnets, below the surface. Owing to friction, the horizontal force on either pole of the particle will be effective only when that pole is raised from the surface; that is, after the upward vertical force has passed a definite value The particle as a whole will, therefore, move oppositely to the magnets below, each pole of the particle stepping out alternately. It is clear that remanent magnetism is necessary for these effects to occur, and that their magnitude will depend on the shape and mass of the particles as well as on their magnetic characteristics The behaviour of particles under more complex conditions can readily be given on the above basis

Constitution of Xylan Previous work on the structure of the polysaccharide xylan revealed that the substance was composed of chains of xylopyranose units linked through the 1–4 positions of the pentose molecule The glycosidic linkages were known to be β in type, and in many ways xylan presented close structural analogies with cellulose More recent investigations by W N Haworth, E L Hirst and E Oliver (*J Chem Soc*, 1917, 1934) show that xylan prepared from esparto celluloses of different origin is possibly more closely related to the plant gums than to normal cellulose It contains, in addition to the xylopyranose residues, a fixed and constant proportion of combined *l* arabinose in the furanose form This *l*-arabofuranose unit is retained during methylation and the methylated xylan gives on hydrolysis 90 per cent of 2 3 dimethyl xylose and about 6 per cent of 2 · 3 5 trimethyl *l*-arabofuranose The last product shows that the arabinose residue must be present in the furanose condition in xylan and that it forms a terminal group attached to a chain of consecutive xylopyranose residues—the first occasion on which the natural occurrence of arabofuranose has been observed Xylan is non-reducing, and previous experiments by Schmidt in favour of a terminal carboxyl group could not be confirmed. Trimethyl xylose has not been detected in the cleavage products of methylated xylan, and it seems evident that the trimethyl arabofuranose takes the place of this as a terminal group in what is otherwise a series of xylopyranose units Alternative structures which are possible in the present stage of the investigation are considered

The Spectroscopic Binary ζ Aurigae Work performed at Cambridge at the recent eclipse of the variable ζ Aurigae is described in the November *Monthly Notices R A S* This spectroscopic binary is also an eclipsing variable and consists of a *K* type super giant and a *B* star, and has an especial interest since it is the first accurately to give the dimensions and mass of a red supergiant from observations alone The Cambridge observations consisted of an accurate measurement of the magnitude difference between the normal and eclipsed system, made by Dr. W M Smart with a photo-electric photometer. The difference was found to be 2·281 m, with the very small probable error of 0·004 m At the same time, spectroscopic observations were made at the Solar Physics Observatory These are described by Dr A. Beer. A remarkable feature is the appearance of the Ca+ lines in absorption in the violet spectrum of the *B* star when this star emerges from the eclipse. Naturally, these lines are absent from the normal *B* spectrum, which is readily distinguished from the *K* spectrum in the violet by its greater intensity The appearance of the Ca+ lines is due to the passage of the light from the *B* star through an extensive Ca+ chromosphere or envelope carried by the red star As the *B* star moves clear of the eclipsed position, these Ca+ lines decrease in intensity. The distance between the two stars is about 10^{16} km, and their diameters 335 and 2½ times that of the sun, for the red supergiant and *B* star respectively.

Twenty-second Session of the Indian Science Congress

THE twenty-second session of the Indian Science Congress was held at Calcutta on January 2–8 The session was memorable for the foundation of the National Institute of Sciences of India, which it is intended shall perform for India some of those functions which the Royal Society discharges with regard to science in the United Kingdom The foundation of this Institute forms a land-mark in the organisation of scientific research in India. The inauguration ceremony of the National Institute was performed on January 7 by His Excellency Sir John Anderson, Governor of Bengal, when Dr L. L. Fermor, president, delivered his presidential address.

His Excellency Lord Willingdon, Viceroy and Governor-General of India, opened the session on January 2 In his speech, Lord Willingdon referred with satisfaction to his being the first Viceroy to be present at its meetings, and mentioned briefly the importance of the contribution to Indian science being made by Government through scientific services and scientific departments, and through the agency of bodies like the Imperial Council of Agricultural Research and the Indian Research Fund Association After mentioning the munificent endowments for scientific research created by men like the late Sir Jamshetji Tata, the late Sir Tarak Nath Palit and the late Sir Rash Bihari Ghosh, he mentioned specially the growing contact between scientific research and the practical demands and requirements of industry, of which the assistance given by the Burma Oil Company to the foundation of the College of Engineering at Rangoon, and the recent donation of Messrs Steel Brothers for research in oil technology at Lahore, are examples In concluding, he referred to the necessity for scientific workers to organise themselves so as to ensure the maximum of achievement that is possible with the resources available.

In his presidential address, Dr J H. Hutton referred briefly to the work of the Academy Committee appointed at the Bombay session and recommended the scheme for the foundation of a National Institution of Sciences of India for adoption by the Congress. He then referred to the vast field available in India for the organised efforts of science, and cited rural economy, food reform and town planning as matters in which science may and should be utilised and directed for the benefit of the community Speaking of the vast field India offers to anthropologists, containing as it were a veritable museum of living physical types, of social organisations, cultures and religious beliefs, he pointed out that the question of race in India requires very careful and detailed examination by trained anthropologists. He directed attention to the numerous sites of archæological interest awaiting excavation and to the great need for systematic linguistic research in southern India. The necessity of studying the symbolism of dreams, folk-lore proper and religious beliefs and practices was emphasised and an appeal was made to concentrate more on the organised collection of facts than on their interpretation.

In his presidential address to the Section of Agriculture, Dr. F. J. F. Shaw laid stress on the necessity and importance of systematic breeding work for resistance to disease In this connexion he mentioned the production at Pusa of new types of Rahar (pigeon pea—*Cajanus indicus*) resistant to the wilt disease caused by *Fusarium*. He also mentioned that a comprehensive scheme for breeding rust-resisting types of wheat has recently been undertaken by the Imperial Agricultural Department, from which it is hoped fruitful results will be obtained After referring to breeding work done on linseed, potato and sugar-cane in India, he pointed to the necessity of a cytological study of these crops He hoped for co-operation in this sphere from the universities of India.

At a joint meeting of the Sections of Agriculture, Mathematics and Physics, Chemistry, Botany, Geology and Zoology, it was decided to start an Indian Society of Soil Science

The presidential address by Prof N. R Sen to the Section of Mathematics and Physics was a general review of the development of theoretical physics from the early stage of classical mechanics to the present state of quantum mechanics, laying special stress on the difficulties of the existing theory. The viewpoints of the two rival schools of thought, namely, of a continuous field theory being able to describe correctly the entire scheme of Nature, or of discontinuous quantum processes ultimately finding a solution to the problem of matter and radiation, were analysed and discussed.

Among the papers read at the meetings the following may be mentioned: (1) atomic arrangements in anthraquinone crystals, by Dr K. Banerjee, (2) aerial waves produced by meteorites, by Dr S K Banerjee, (3) meteorological papers on nocturnal cooling of the atmosphere by radiation, by Dr K R Ramanathan and Mr Ramdas, (4) Heilbronn's class-number, by S Chowla, (5) some boundary problems in non-linear parabolic equations, by R Siddiqi, and (6) two hydrodynamical papers, by N. Bose and S. Sen Gupta

In his address to the Chemistry Section, Dr. A C. Sarkar gave a review of recent work on high coal-tar hydrocarbons, especially acenaphthene, fluorene and phenanthrene Symposia were held on chemical aspects of light absorption and cellulose chemistry.

The presidential address of Diwan Anand Kumar to the Zoology Section dealt with the spicules and classification of Tetraxonida, an order of non-calcareous sponges. Apart from the papers read, the Section discussed at its meetings the question of "Standardisation of the Courses in Zoology for the University Examinations" and at a joint meeting of the Botany and Zoology Sections the "Teaching of Elementary Biology in Secondary Schools in India". The Section adopted a resolution stressing the need for the establishment of a station for marine and estuarine biology in Bengal. A committee was also appointed to organise a Zoological Society for India.

Prof. J. H. Mitter, in his presidential address to the Botany Section, dealt exhaustively with mycological and plant pathological research in India. He laid stress on the need of co-operation between universities and the plant pathologist, who has not always much time at his disposal to carry out the purely scientific work on the life-history of the pathogen. He further pointed out the desirability of establishing a bureau of stock cultures of fungi and the publication of an up-to-date textbook on mycology for India

The problem of cereal rusts in India was discussed at a joint meeting of the Botany and Agriculture

Sections. Dr. K. C Mehta, Dr U N Pal, Dr F J F Shaw, Mr P. K. De and Dr. B B Mundkur took part in the discussion

The presidential address to the Geology Section by Dr M S Krishnan dealt with the classification of the Dharwar system of Pre-Cambrian rocks. A three-fold division was suggested in which the lowest consists of a metamorphosed complex, while the middle division is characterised by manganese ores (gondite type) and marbles, and the upper one by banded ironstones. The origin of some of the types of sediments in this system was discussed in the latter part of the address

In addition to the papers which were contributed to this Section, there was a symposium on the Bihar earthquake of 1934, jointly with the Physics Section, in which Drs. A C Banerji, S. K Banerjee, C W B Normand and S C Roy and Messrs D N Wadia and W D. West took part S K Banerjee touched upon some general facts and exhibited a model of a seismograph of his own design suited for recording severe shocks near the focal region , A C Banerji discussed the inter-relationship of the cooling of the crust and the distribution of radioactive material in the earth, and also the influence of the tidal attraction of the sun and the moon in precipitating an earthquake in an unstable crust Roy illustrated his remarks with actual seismograms and the various phases found therein According to him the focal depth of this earthquake was about 13 5 km , and the speed of one phase coincided with that in dunite. Normand emphasised the necessity for more seismographs and especially damped instruments in the Indo-Gangetic valley adjoining the Himalayan seismic belt Wadia dealt with the geological aspects and on the possibility of the existence of fractures parallel to the 'Main Boundary Fault' underneath the Ganges valley in Bihar, while West from geodetic considerations thought that the earthquake might have been produced by the conversion of the rocks of the eclogite and dunite shell into those of less density.

Major K R K Iyengar devoted his presidential address to the Section of Medical and Veterinary Research to the consideration of the problem of rabies in India He pointed out that all attempts to cultivate artificially the organism causing it having failed, it is not possible to improve upon the somewhat crude methods employed at present to prepare the serum and to devise more efficacious means of prophylactic treatment Certain improvements in the technique of preparing serum adopted during the previous year at Coonoor were described It was further pointed out that although a number of institutes for anti rabies treatment have been established in India, no preventive measures are being taken to deal with the disease at its source Referring to the example of Germany, Australia and the British Isles where rabies has been eradicated by strictly controlling dogs and their movements, Major Iyengar pressed for co-operative efforts for the destruction of stray ownerless dogs, and for the compulsory registration and licensing of dogs in all municipalities and district boards He advocated destruction of jackals as well in rural areas Quarantine methods against imported dogs, in his opinion, would not be effective unless the local dog population is properly controlled He recommended that anti-rabies treatment should be decentralised to the utmost extent possible, so that persons bitten by dogs could have treatment near their homes

A symposium on vitamins was held at a joint meeting of the Sections of Chemistry and Medical and Veterinary Research

Dr G. S Ghurye took "Anthropology and our Educational System" as the theme of his address to the Anthropology Section If anthropology is to serve as a guide to better social conditions, a study of the social and cultural history of the various races of mankind, primitive as well as advanced, is very necessary Such a study would help in suggesting solutions to many pressing social problems: It was therefore suggested that anthropology should be included as a subject in all courses of study prescribed for students wishing to take up public life in one form or other as their career.

The Section adopted a resolution to start an Anthropological Society for India, if possible by enlarging the scope of the Bombay Anthropological Society

In his address to the Psychology Section, Dr S C Mitra dealt with the relation of psychology to problems of life After pointing out the various ways in which a knowledge of psychology can be utilised to solve social problems, he pressed for the establishment of an Institute of Applied Psychology

S P AGHARKAR.

Underground Water Supplies

ALTHOUGH the title of his paper, read before the Royal Society of Arts on February 20, was "Water Supplies from Underground Sources", Lieut -Col. J. D Restler gave it a rather wider scope by including some preliminary notice of water supplies in general He pointed out that the problem of water supply is very different from that of the supply of gas and electricity, because gas and electricity can be manufactured for all practical purposes at any point where it is desired to do so, and electricity can be transmitted in bulk over long distances with comparative ease and relatively high efficiency, whereas in the case of water, serious engineering difficulties arise if large quantities are to be delivered over long distances. The capital cost becomes very heavy and the efficiency, due to pipe friction and other causes, is exceedingly low.

Dealing more particularly with the subject of subterranean supplies, Col. Restler described the conditions under which they have to be obtained In sinking a well, or boring, in many localities, it is quite usual to pass through a large number of strata yielding water of an entirely different character, separated in some cases by comparatively few feet The classes of water met with vary to such an extent that some may be so soft as to attack lead pipes, and others so hard as to be entirely unsuitable for steam raising or domestic purposes Others again, right in the centre of England, may be quite salt As a general principle, if underground water of suitable quality can be found in sufficient quantity at a convenient depth and within a reasonable distance of the locality where it is required, such a source, from a water undertaking point of view, has great advantages over a surface or river source Underground sources of supply are less liable to contamination, assuming that there is a sufficient covering of impervious strata and that the outcrop lies in an area where only pure rain water is collected.

The engineering works required for obtaining water from water-bearing strata may be divided into three sections, the first being small borings, such as those required for the supply of small quantities to country houses, medium size factories, etc., the second section would comprise large borings, such as those required for public water supply undertakings or large manufacturing works, and the third section would consist of large wells, with headings or galleries, such as those required for the supply of large towns and cities. Borings under the first category would be capable of delivering water at the rate of about 100,000 gallons in twenty-four hours, those in the second category at the rate of about two million gallons in twenty-four hours, and those in the third category at a rate exceeding five million gallons in twenty-four hours. The first and second classes have many points in common, the principal difference being that the plants and apparatus required in the second case are considerably larger and heavier. The paper then went on to describe the procedure of making the borings and sinking the lining tubes.

In the course of his paper, Col. Restler mentioned that water derived from an underground source is, in very cold weather, many degrees higher in temperature than water derived from a river source, and that it is quite noticeable that the former does not freeze in mains or service pipes so soon as river water. This is a point of practical importance, because when very cold water is being transmitted through mains, it frequently produces a local contraction in the metal and causes cast iron pipes to fracture.

Post-Glacial Research in Ireland

IT has been evident for many years that a large number of the special problems of plant and animal distribution in Ireland could only be solved if it were possible to obtain trustworthy evidence as to the major post-glacial changes in the Irish fauna and flora. Accordingly a committee was formed in 1933, with the object of promoting detailed investigations of representative glacial and post-glacial deposits and, particularly, of enlisting the method of pollen analysis in the detailed study of the problem. The work and aims of the committee up to the end of 1934 are summarised by various authors in the November number of the *Irish Naturalist* (5, 125, 1934). Active field work was commenced in 1934, so that full details of the results are not yet available. The particular feature of the work was, however, that the sites examined were chosen because they included definite and representative archæological horizons in various parts of the country.

An outline of the broad results of the pollen analyses of peats is given by Prof. Knud Jessen, and this indicates the main features of the work attempted. From results on the deeper bogs examined, the tentative suggestion is made that there was an increase in moisture in the later part of the Bronze Age, which occasioned wide-spread replacement of forest by peat bog. If, as is possible, this change corresponds in time with the sub-boreal to sub-Atlantic climatic change so well known on the Continent, the late Bronze Age in Ireland should synchronise with the beginning of the Iron Age (Halstatt period) in Europe. Before this transition, Ireland was forest clad to the western coasts and high up the mountains. Since then, forests have disappeared from western Ireland.

Investigations carried out in Northern Ireland were devised to secure, if possible, chronological comparisons between the raised beaches and the development of inland bogs containing Stone Age culture layers. The results will be awaited with interest, as will those from the Lough Neagh area, where the discovery of fossil *Naias flexilis* fruits may throw light on the origin of the American element in the Irish flora. The late glacial deposits of the Ballybetagh bogs, the classical site for remains of the Irish 'elk', yielded a collection of northern or highland types of plants apparently of a date prior to the post glacial birch epoch.

University and Educational Intelligence

CAMBRIDGE.—Mr. K. W. M. Pickthorn, fellow and tutor of Corpus Christi College, has been returned unopposed as National Conservative member of Parliament for the University. His was the only nomination for the seat vacant by the resignation of Mr. G. H. A. Wilson (Conservative), Master of Clare College, who is to be the next vice-chancellor of the University.

LONDON.—The Senate, at its meeting on February 21, approved a proposal to hold external examinations of the University in New York. This proposal, which is an entirely new departure in the history of the University, was submitted by His Excellency the American Ambassador and the British Foreign Office to the State Department in New York, which has given its formal sanction. These examinations are to be available for both British subjects and students of other nationalities.

The Court has accepted the offer by the Radcliffe Trustees of the Radcliffe 24-in. refracting telescope, which was the main instrument of the Radcliffe Observatory in Oxford and has now been rendered available by the removal of this Observatory to South Africa. It is hoped, so soon as funds can be obtained by the University for this purpose, to re-erect the Radcliffe telescope on the site of the present University of London Observatory in Mill Hill Park, where the Wilson 24-in. reflector and the Fry 8-in. refractor, as well as other instruments, are already housed.

APPLICATIONS are invited for Lady Tata Memorial Research Scholarships in medicine, of £400 a year each, for research work in diseases of the blood with special reference to the leukæmias. These scholarships are renewable annually up to a normal maximum of three years, and there are likely to be at least two vacancies for new candidates ready to begin work in October 1935. The scholarships are open to suitably qualified men or women of any nationality, and are ordinarily awarded on a whole-time basis. Applications must be made by April 15. Further particulars and forms of application may be obtained from the Secretary, Scientific Advisory Committee, 138 Bedford Court Mansions, London, W.C.1.

AMERICAN university statistics are exhibited and interpreted in an article by Dr. Walters, president of the University of Cincinnati, in *School and Society* of December 15. The outstanding feature of the returns is the reversal of the tide of enrolment, which has been ebbing since 1930. This recovery, which is much greater in institutions under public control than in others, and is most pronounced in the mountain and south central States and least in New England and middle Atlantic States, is attributed to the following influences. financial aid for students from the Federal Emergency Relief Administration, the difficulty of finding employment for young people leaving school, improved economic conditions in some parts of the country and the persistent faith of parents in the value of higher education 'Liberal arts' continues to be the most popular choice of entering students, although its percentage (72) of the total entries was slightly lower in 1934 than in the preceding year Some striking increases in the entries into the various professional schools were 48 per cent in agriculture, 27·5 per cent in commerce and business administration and 20·5 per cent in engineering. Another statistical article in the same issue directs attention to the fact that one tenth of the expenditure of Yale University last year was on assistance to students in need of financial aid

Science News a Century Ago

Resumption of Work on the Thames Tunnel

The construction of Brunel's tunnel beneath the Thames from Rotherhithe to Wapping began in 1825, had been brought to a premature close in 1828, and for nearly seven years work was at a standstill. In 1834, however, a "Tunnel Club" was formed, principally by fellows of the Royal Society, and successful efforts were made to secure assistance from the Government for the completion of the tunnel At a meeting of the shareholders held on March 3, 1835, in the City of London Tavern, the chairman announced that £247,000 in exchequer bills was to be advanced on the security of the property He said that "the Company were much indebted to the late Government, as well indeed as to the present, for this aid Great credit was due to all those who had advocated the grant of money, and among those who had formed the deputation to the Government were men of all parties. It had indeed, been the wish of all persons, at home and abroad, that this splendid work should be completed, and foreigners considered it a national disgrace that it should have been allowed to remain seven years without an attempt being made to complete it The time, however, was not far distant when it was confidently believed this magnificent work would be completed." At the same meeting, Brunel made a report in which he said that on February 4 "the water-ways, which had been closed for several years were reopened, as a preparatory step for entering the shield It was quite satisfactory to find that the infiltrations are very inconsiderable, and are just the same as they were before" The tunnel was opened to the public on March 25, 1843.

Bessel's New Method of Lunar Distances

An advertisement in *The Times* of March 8, 1835, announced: "This day is published, 8vo, 5s, BESSEL'S NEW METHOD OF LUNAR DISTANCES— Distances of the Sun and the four planets Venus, Mars, Jupiter and Saturn, from the Moon, calculated according to Mr. Bessel's method, together with their places for every day in the year 1835, to which is added, an Ephemeris of the Moon calculated for every third hour of mean Greenwich time upon M. Damoiseau's Tables; the culmination of the Moon for every day in 1835 for the Altona meridian, with the auxiliary quantities to reduce it to other meridians, and Tables for finding the Latitude by the Pole Star for 1835, calculated under the direction of H C Schumacher John Murray, Albemarle St "

Sir Robert Peel and Mrs. Somerville

After offering a Civil List Pension to Airy, Sir Robert Peel wrote in March 1835 to Mrs Somerville, saying, "In advising the Crown in respect of civil pensions, I have acted equally with a sense of public duty and on the impulse of my own private feelings in recognising among the first claims on the Royal favour those which are deserved from eminence in science and literature In reviewing such claims, it is impossible that I can overlook those which you have established by the successful prosecution of studies of the highest order, both from the importance of the objects to which they relate, and from the faculties and acquirements which they demand
I am enabled to advise His Majesty to grant to you a pension on the civil list of two hundred pounds per annum, and if that provision will enable you to pursue your labours with less of anxiety, either as to the present or the future, I shall only be fulfilling a public duty, and not imposing upon you the slightest obligation, by availing myself of your permission to submit such a recommendation to the King" The pension was conferred on Mrs Somerville and later, when Lord John Russell was Prime Minister, it was increased to £300 a year

Death of Thomas Drummond

Early in March 1835, Thomas Drummond, the botanical collector, died at Havana, after spending ten years collecting in North America. The younger brother of James Drummond (1784 ?–1863) who investigated the botany of Western Australia, Thomas Drummond began life as a nurseryman in Forfar, but became known to botanists by distributing sets of mosses. In 1825 he was selected as assistant naturalist to Dr (afterwards Sir John) Richardson in Sir John Franklin's second land expedition in connexion with the discovery of a North-West Passage. He accompanied the expedition westward by the Hudson and Lakes Ontario and Winnipeg to the Mackenzie River, but quitted the main party at the Rocky Mountains. His subsequent botanical expeditions took him on foot across the Allegheny Mountains to St Louis, to New Orleans and to Texas At Velasco he was attacked by cholera but was afterwards able to continue his excursions He finally embarked for Havana on February 9, 1835 The plants he sent home were described by Sir William Hooker in his "Flora Boreali Americana", his "Journal of Botany" and in the "Companion to the Botanical Magazine"

Objects for the Microscope

In the *Records of General Science* of March 1835 under the heading "Scientific Intelligence", it is stated that "Mr Andrew Pritchard, Pickett Street, Strand, has just published a useful little work for such persons as take an interest in examining the beauties of the minute works of nature It consists of a list of 2000 microscopic objects, and is intended to serve as a guide for selecting and labelling subjects of natural history, botany and mineralogy Some good observations are prefixed in reference to mounting microscopical subjects, with remarks on the circulation of animals and plants"

Societies and Academies

London

Royal Society, February 21. **F W Aston** The isotopic constitution and atomic weights of hafnium, thorium, rhodium, titanium, zirconium, calcium, gallium, silver, carbon, nickel, cadmium, iron and indium. Mass-spectrograph analyses both by anode rays and the ordinary discharge have been made of thirteen elements Rays from some twenty new isotopes were discovered in all The atomic weights estimated by the photometrical measurements of abundance are generally in good accord with the accepted ones In the case of cadmium, success was attained in an unexpected manner and interesting observations were made on the behaviour of metallic methyls in the discharge Work on the isotopic constitution of elements is now fairly complete All but four, palladium, iridium, platinum and gold, have given positive results of some sort Some 247 stable isotopes are known and one of the most astonishing facts revealed is the occurrence of a stable elementary atom for practically every natural number up to 210 **J M Stagg** The diurnal variation of magnetic disturbances in high latitudes For some years it has been known that irregular, short-period perturbations ('disturbances') in the earth's magnetic field at a few isolated localities have a daily variation in their time of incidence, but it was not known whether the variation is governed by local or universal time or how it is affected by magnetic latitude Using the records from ten magnetic observatories in both hemispheres, it has been established that short period irregular disturbance is controlled by local time up to the magnetic axis pole Below magnetic latitude 70°, the variation in disturbance has a dominant single maximum in the late evening throughout the year, above 80° its phase is reversed and the transition from summer to winter conditions involves radical change both of type and scale In the intermediate zone the incidence of disturbance varies also with season and with the state of general disturbance, both forenoon and evening maxima being conspicuous

Paris

Academy of Sciences, January 14 (*C R*, 200, 77–268) **Julien Costantin**: The practical consequences of the germination of potato seeds in the mountains The art of raising potatoes from seed requires a special technique which is not generally known. This is of importance in connexion with the production of strains of potatoes capable of resisting disease, and details are given **Henri Vallée** was elected *Correspondant* for the Section of Rural Economy. **I. Vinogradov** · A new variant of the demonstration of Waring's theorem **Tibère Popoviciu**: Remarks on the algebraic equations the derived equations of which have all their roots real. **Paul Dubreil** · An ideal attached to a skew algebraical curve defined by its monoidal representation. **Simon Stoïlow**: The topological characterisation of Riemann surfaces **Georges Tzitzéica** · Certain networks. **Jean Louis Destouches**: A new conception of physical space. **B Gambier**: Quadrics with one parameter touching their envelope along two conics. **St Golab**: The measurement of areas in Finsler spaces **Florin Vasilesco**: The method of *balayage* of Poincaré extended by M. de La Vallée Poussin, and its relations with the generalised problem of Dirichlet. **Robert Meynieux**: The continuous functions of a real variable which possess a theorem of algebraic addition. **G. Dedebant, Ph. Wehrlé** and **Ph Schereschewsky**: The maximum of probability in permanent movements Application to turbulence. **Albert Toussaint**: Contribution to the study of infinite multiplanes in a plane current **Julien Kravtchenko**: Theorems of validity in problems of wakes **Mme Marie Louise Dubreil-Jacotin**: The theorems of existence relating to permanent periodic waves in two dimensions in heterogeneous liquids. **Pierre Chevenard**: A micromachine with photographic registration for the mechanical testing of metals This machine utilises test-pieces of 1–1 5 mm diameter only, an advantage when dealing with costly alloys An outline of the possible applications of the machine is given **Georges Maneff** The effects of the theory of relativity **Jean Dufay** and **Mlle M Bloch**. Rapid changes in the spectrum of Nova Herculis. Absorption bands attributed to cyanogen Discussion of observations made at the Lyons Observatory The rapid changes noted about December 25 and 27 appear to be due to a large cyanogen absorption band, the head of which is at 4216 A This appears to be the first time cyanogen bands have appeared in a Nova **Bernard Lyot** The spectrum of the solar corona in 1934 Eleven diagrams are given showing the intensities of the green line observed in 1934 **Paul Bernard** The absence of hysteresis in piezo-electric phenomena An experimental study of the effect of the rate of increasing or decreasing the pressure on the quartz on the quantities of electricity set free No such effect could be measured and hence there is no hysteresis **L G Stokvis** The geometric loci of the neutral point of a triphase system **Pierre Jacquet** The adsorption of certain colloids by metallic surfaces and its influence on the structure of electrolytic deposits **André Aron** The magnetic properties of thin sheets of nickel Study of semi-transparent nickel films deposited in hydrogen or in nitrogen, with special reference to the effect of temperature on the Curie points. **Adolfo Williams** The persistence of intercombination lines [of the spectrum]. **Paul Mondain-Monval** and **Roger Wellard**: The influence of temperature on the explosion of mixtures of air and hydrocarbons Experiments bearing on the causes of knocking in internal combustion motors: the results support the peroxide theory **Pierre Montagne**. The calculation and graphical representation of the elementary displacements in reactions of homogeneous chemical equilibria. Variations of temperature and pressure **Jean Perreu** · The calorimetry of saline solutions · system sodium sulphate, magnesium sulphate, water. **Louis Domange**: The action of steam on copper fluoride. **Alexis Tchitchibabine** and **Michael Bestougeff**: The action of ethylene oxide on hydrogen sulphide. The primary reaction product is thioethylene glycol, $HO.CH_2.CH_2.SH$, but if the temperature is allowed to rise, further condensation takes place, one of the products being a strong base, triethylolsulphinium hydroxide **Jean Tabuteau**: The oxidation of carvomenthene by selenious anhydride. The synthesis of carvotanacetol. **Edmond Saurin**: Some deposits of tectites of southern Indo-China. **Norbert Casteret** · The deepest known penetrable hydrogeological opening, the Martel abyss (Ariège). **Emmanuel de Martonne** Areism and the movements of the soil in the Argentine plains. **Marcel Mascré** and **Mlle. Alice Rollen**: The influence of tensio-negativity on the structure of the plant cell. ALBERT MAIGE: The variations of plastidal imbibition during chloroplastogenesis, amylogenesis and amylolysis. J. MAGROU: The immunity reactions of plants towards *Bacterium tumefaciens* MLLE JEANNE LEVY, MLLE DENYSE KOHLER and L JUSTIN-BESANÇON · The relations between the constitution of some aminoether oxides and their pharmacodynamical actions MLLE MARIE LOUISE VERRIER: The comparative morphology of the visual cells and the theory of duality of vision ALBERT VANDEL · The crossing of geographical races of *Trichoniscus* (*Spiloniscus*) *provisorius* giving an exclusively male descent W KOPACZEWSKI · The jellying of human serum by acids

LENINGRAD

Academy of Sciences (*C R.*, 4, No 5–6) I VINOGRADOV · A new evaluation of $G(n)$ in Waring's problem A GORGIDZE A method of successive approximations as applied to a problem of the theory of elasticity A POPOV: Some applications of the simplest discontinuous functions I ASTAPOVITCH. New determination of the mean heliocentric velocity of meteors by means of the diurnal variation method J SEKEZH-ZENKOVITCH The problem of a discontinuous movement of a liquid around a circle B. GALERKIN Contribution to the theory of an elastic cylindrical shell E. GAPON and D IWANENKO Alpha-particles in light nuclei N NYBERG The possibility of approximate spectrophotometry without obtaining a spectrum. N ORLOV A new synthesis of the hydrocarbons of the C_nH_{2n+2} series The proposed synthesis of saturated aliphatic hydrocarbons differs from all those previously described by the complete hydrogenation of the furane derivatives I. NAZAROV: The action of metallic sodium on fatty ketones (3) The reaction between metallic sodium and isobutyrone A PETROV and L. ANCUS: Low temperature hydrogenation and polymerisation of acetylene in the presence of nickel catalysts Liquid products of hydrogenation and polymerisation of acetylene were obtained both at atmospheric pressure and temperature of 180°–200° C., and at increased pressure (up to 25 atmospheres) and temperatures not above 40° C. V. TCHELINTSEFF · Acid oxygenetic organic compounds. L. NIKITIN: On some acoustic electrochemical phenomena. V. KARASIK and M LIKHATCHEV: The relation between the chemical nature and biological activity of dihydroxide of methyl-diphenylarsine and its derivatives V. SOLOVJEV: Hydromodulus of the spring wheat, *T durum*, in the Transvolga hills A. POTAPOV · Tyrosinase of tea leaves, and its probable rôle in tea manufacture G. MOLOTKOVKIJ: Determination of the coefficient of ventilation in leaves. The coefficient of ventilation is the volume of air, in cubic millimetres, passing through one stoma in a second. A method for its determination is described. I. KOLOMIEC: Scheduling the dates of watering and drought in accordance with the stages of plant growth as a means of controlling the yield. A. VACENKO Inheritance of glume pubescence and of the black colour of the ear in *T. durum*. A. SVETOVIDOV: Geographical variability of *Coregonus lavaretus pidschian* V ARGAMAKOVA · Some Ophiuræ from the east coast of Sakhalin *Ophiocten miocaenicum*, another *Ophiocten* species and *Amphiophiura aenigma* are described from Miocene deposits of the Island of Sakhalin.

SYDNEY

Royal Society of New South Wales, November 7 J C EARL and H. M. PARKIN The fastness of certain aminoazo dyes to washing Aminoazobenzene and its *N*-methyl, *NN*-dimethyl, *N*-benzyl and *NN* methyl benzyl derivatives were studied comparatively as regards the fastness to washing of dyeings on wool made with them under exactly similar conditions The *p*-sulphonic acids of the last four of the above compounds were also compared In both series the *NN*-methyl benzyl derivatives were very much faster to washing than the other dyes. F. P DWYER and D P MELLOR: Compounds of palladium with benzildioxime An investigation of the compounds of palladium with the isomeric forms of benzildioxime has shown that palladium is strictly analogous to nickel, in that one molecule of the metal is co-ordinated with two molecules of α (anti)-benzildioxime and with one molecule of γ (amphi) benzil dioxime However, unlike all the common metals and the other metals of the platinum group, palladium gives an insoluble compound Pd $(C_{14}H_{10}N_2O_2)$ with β (syn)-benzildioxime J G CHURCHWARD Note on the occurrence in New South Wales of black chaff of wheat caused by *Bacterium translucens*, var *undulosum*, S J and R Infected stems, leaves, chaff and grain of commercial and other varieties were found in several wheat-growing districts in New South Wales Work at the University of Sydney would suggest that the disease is widespread and has been present in New South Wales, unrecognised, for a number of years The extent of the losses caused by it are not yet known A number of the most popular varieties of wheat in New South Wales are susceptible C C TOWLE · An inquiry concerning a certain conventionalised type found along the coast of New South Wales Of the flaked stone implements found, the conventionalised types are essentially asymmetrical in form, and various interpretations have been given concerning the uses to which they were put by the aborigines Systematic inquiry shows that the most probable reason for the asymmetrical form of the implements was the highly refractory nature of the material available for flaking For several reasons, the flakes of this form produced the most satisfactory implements The conventionalised implements dealt with in the paper have been classified as scrapers, and they have been correlated with some of the conventionalised scrapers from the far western areas of New South Wales The implements from those parts where a tractable material was available are more symmetrical in form M. B. WELCH The moisture equilibrium of timber in different parts of New South Wales (2) Murwillumbah. During the period October 1930–October 1932, a moisture equilibrium investigation was conducted at Murwillumbah, New South Wales. It has been found that in general the atmospheric humidity conditions are higher than at Sydney, and the mean moisture content of ten different timbers kept indoors over the period was 13 2 per cent, whereas similar timber under the same conditions at Sydney showed a mean of 12 0 per cent. Periods of very high humidity were found to occur during which the mean monthly moisture content for timbers such as tallowwood and blackbutt was in the vicinity of 16 per cent and Queensland maple exceeded 17 per cent. During such periods, satisfactory air seasoning of timber for the Sydney market does not appear to be practicable.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, March 4

British Museum (Natural History), at 11 30.—Dr. Susan Finnegan "Arachnids Injurious to Man".*

University of Cambridge, at 5 —Sir Daniel Hall: "The Pace of Progress" (Rede Lecture) *

University of Leeds, at 5 15 —Prof F A E Crew "Biology and Human Affairs".*

King's College, London, at 5 30 —Prof J S Lee "The Geology of China considered in Relation to Secular Movements" (succeeding lecture on March 11) *

Royal Geographical Society, at 8 30 —Prof E P Stebbing "The Encroaching Sahara"

Wednesday, March 6

Royal Society of Arts —Sir Henry Richards · "The Problem of Noise"

Society of Public Analysts, at 8 —(at the Chemical Society's Rooms, Burlington House, Piccadilly, W 1) — Annual General Meeting

Dr. Bernard Dyer An Address giving Reminiscences of the Society and some of its Prominent Members

British Science Guild and Royal Institution, at 9 —(at the Royal Institution) —Sir Frederick Keeble "The Fertility of the Earth" (Research and Development Lecture)

Thursday, March 7

Bedford College for Women, at 5 15 —Sir Arthur Eddington "Time and Entropy" *

Friday, March 8

University College, London, at 5.—Dr. A. Michels. "Some Results of High Pressure Measurements in Gaseous and Liquid Systems" (succeeding lecture on March 15) *

Royal Institution, at 9 —Sir John Russell · "The Future of British Agriculture".

Society of Chemical Industry, March 8.—Conference on Meat to be held at the University of Liverpool

3–5 "The Chemistry of Meat"

6–7 30 "Meat Storage"

Institute of Metals, March 6–7 Annual General Meeting to be held at the Institution of Mechanical Engineers, Storey's Gate, London, S W 1

Official Publications Received

Great Britain and Ireland

University of London Institute of Education Studies and Reports, No 4 The Yao Tribe, their Culture and Education, by Benno Heckel, Arts and Crafts in the Training of Bemba Youth, by Griffith Quick Being Reports presented to the Department of Colonial Education in the Institute Pp 53 (London Oxford University Press) *2s* net

University of Leeds Thirtieth Report, 1933–34 Pp 162 Publications and Abstracts of Theses by Members of the University during Sessions 1933–34 Pp 34 (Leeds)

Empire Cotton Growing Corporation A Review of the Work of the Experiment Stations, Season 1933–34 By Dr J. C. Willis. Pp 88 (London Empire Cotton Growing Corporation) *1s 6d*

The British Electrical and Allied Industries Research Association (Incorporated) Fourteenth Annual Report, October 1, 1933, to September 30, 1934 Pp 131 (London)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No 12 The Genus *Pitys*, Witham, emend By Prof. W. T Gordon Pp 279–311 + 8 plates. (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd) *7s*

The National Institute of Agricultural Botany Fifteenth Report and Accounts, 1933–34 Pp 23 (Cambridge)

Quinine Manufacture in India By George Elliott Shaw (Seventeenth Streatfeild Memorial Lecture, 1934.) Pp. 16 (London Institute of Chemistry)

Other Countries

Mémoires du Musée Royal d'Histoire Naturelle de Belgique No 59 Contribution à l'étude de *Pinakodendron Ohmanni* Weiss Par Dr A Rousseau Pp 32 + 4 plates No 60 Beitrag zur Kenntnis der Rhizopoden, morphologische und systematische Untersuchungen und ein Klassifikationsversuch Von Dr Henri De Saedeleer Pp 112 + 8 plates. No 61 Les Brachiopodes du Dinantien de la Belgique Par F Demanet. Pp 116 + 10 plates No 62 Recherches sur les parasites des mollusques terrestres de Belgique—Trématodes larvaires Par W Adam et E Leloup Pp 40 Memoires, Hors série Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA RR le Prince et la Princesse Léopold de Belgique Publiés par V Van Straelen Vol 2, Fasc 14 Opisthobranches et Silicodermés (Oncidiades), par A Labbé, Prosobranches parasites, par W Adam Pp 115 + 1 plate Vol 2, Fasc 15 Sponges By H V Bröndsted Pp 27 Vol 2, Fasc 16 Cephalopoda By W Adam Pp 28 Vol 4, Fasc 10 Diptera II, 1 Cyclorrhapha Muscidæ, Calliphoridæ and Tachinidæ by J R Malloch, ii Syrphidæ, par A von Stackelberg, Hymenoptera II, 1 Chrysididæ, di F Invrea Pp 34 (Bruxelles)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol 35, Part 4 Proposition of T N N Equations in the Kinetics of Enzymes By Kenzo Nakajima and Torahachi Kamada Pp 151–291 Vol 37, Part 2 Studies on the Dwarf Disease of Rice Plant By Teikichi Fukushi Pp 41–164 + 6 plates (Tokyo Maruzen Co, Ltd)

Kungl Svenska Vetenskapsakademiens Handlingar Serie 3, Band 13, No 7 Some Statistical Investigations of Eclipsing Binaries By Erik Holmberg Pp 25 Serie 3, Band 14, No 1 Das Wachstum der Körperlänge des Menschen Von Gaston Backman Pp 145. (Stockholm Almquist and Wiksells Boktryckeri A -B)

Meddelanden från Statens Skogsförsöksanstalt, Häfte 28, Nr 1 Redogörelse för Barkborrekampanjen efter Stormhärjningarna 1931–1932 Bericht über die Bekämpfungsaktion gegen Borkenkäfer nach den Sturmverheerungen 1931–1932 Av Ivar Trägårdh och Viktor Butovitsch Pp 258 (Stockholm)

Indian Lac Research Institute Annual Report for the Year 1st April 1933 to 31st March 1934 Pp 35 + 4 plates (Nankum)

Smithsonian Miscellaneous Collections Vol 92, No 9 The Skeletal Musculature of the Blue Crab, *Callinectes sapidus* Rathbun By Doris M Cochran (Publication 3282) Pp 76 Vol 93, No 4 Pioneer Wind Tunnels By N H Randers Pehrson (Publication 3294) Pp. 20 + 4 plates (Washington, D C Smithsonian Institution

The Pasteur Institute of Southern India, Coonoor The Annual Report of the Director for the Year ending 31st December 1933, together with the Twenty-seventh Annual Report of the Central Committee of the Association for the Year ending 31st March 1934 Pp 78 (Coonoor)

Borough of Durban Durban Museum and Art Gallery Annual Report for the Year ended 31st July 1934 Pp 12 + 4 plates (Durban)

Sveriges Geologiska Undersökning Ser C, No 382 Fjällkedjerandens bergbyggnad i norra Jämtland och Ångermanland Av Bror Asklund och Per Thorslund Pp 110 + 4 plates 2 00 kr Ser C, No 383 Fosfathalten i skånska jordar Av O Arrhenius Pp 34 + 4 plates 3 00 kr (Stockholm)

Ministry of Public Works, Egypt Physical Department Helwan Observatory Bulletin No 37 Time Determination and Observations of Wireless Time Signals from 1st of October to December 15th 1933 By M R Madwar Pp 64 + 4 plates (Cairo Government Press)

U.S Department of Agriculture Technical Bulletin No 441 The Biology of *Cremastus flavoorbitalis* (Cameron), an Ichneumonid Parasite of the European Corn Borer By W G Bradley and E D Burgess Pp 16 5 cents Technical Bulletin No 444 Studies on the Mexican Fruit Fly, *Anastrepha ludens* (Loew) By Hugh H. Darby and E M Kapp Pp 20 5 cents Technical Bulletin No 461 Base Exchange and related Properties of the Colloids of Soils from the Erosion Experiment Stations. By C S Slater and H G Byers Pp 20 5 cents (Washington, D C Government Printing Office)

Columbia University Bulletin of Information Thirty-fifth Series, No 17 Announcement of Professional Courses in Optometry for the Winter and Spring Sessions, 1935–1936 Pp 35 (New York)

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ending June 30, 1934 (Publication 3289) Pp. iii + 78 (Washington, D C Government Printing Office)

Memoirs of the Geological Survey of India Vol 65, Part 2 The Geology of Central Mewar By B C Gupta Pp vi + 107–169 + xv + plates 12–21 (Calcutta Geological Survey of India) 4 12 rupees, *8s*

Forest Bulletin No 87 Von Wülfings Yield Tables for Teak Plantations in Java By H G Champion Pp ii + 30 14 annas, *1s 6d* Forest Bulletin No 89 The Effect of Defoliation on the Increment of Teak Saplings By H G Champion Pp ii + 6 3 annas, *4d* (Delhi Manager of Publications)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 86 Mollusks of the Fresh Water Pliocene Beds of the Kettleman Hills and neighboring Oil Fields, California By Henry A Pilsbry. Pp 541–570 + plates 18–23 (Philadelphia)

U S Department of Agriculture Circular No 329 Manufacture, Composition and Utilization of Dairy Byproducts for Feed By Mayne R Coe Pp 16 (Washington, D C Government Printing Office) 5 cents.

Cawthron Lecture, 1934 Conflict and Co-operation, Economic and Political in the Pacific By Frank Milner Pp 25 (Nelson, N Z Cawthron Institute)

Bulletin of the American Museum of Natural History Vol 68, Article 3 Rodents of the Genera Rattus and Mus from the Pacific Islands By G H H Tate Pp 145–178 (New York City)

Catalogues

Short List of Old Newspapers, etc (No. 582.) Pp 8 (London · Francis Edwards, Ltd)

Catalogue of Watson Microscopes Parts 1 and 2 Microscopes and Accessories for all the Biological Sciences 35th edition. Pp. 174 (London · W. Watson and Sons, Ltd.)

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Rationalisation of Scientific Publication

THE social aspects of scientific research, and the view that men of science should take a much more prominent part in spreading a scientific outlook and approach to social and other general problems of the community, have been eloquently urged in recent months Despite these new opportunities and the greater disposition to listen to the contribution he can offer in these matters, the scientific worker often remains his own worst enemy The lack of progress, for example, with all attempts to rationalise the publication and abstracting of scientific literature, or towards effective co-operation between scientific societies, continues to demonstrate an inability of the scientific worker to set his own house in order, if indeed it does not expose him to the charge of fiddling while Rome burns Conservatism can be preserved from inertia and ineptitude only by wise judgment and the assimilation, not the rejection, of new ideas

There are, of course, conspicuous exceptions The Oil and Colour Chemists' Association, for example, has recently appointed a research and development correspondent whose special task is to assist in the interpretation of the results of the latest research work in a form which is easily assimilated by the industry or by the public This is a welcome sign of the recognition of the need for expositors or interpreters of science if industry and society are to utilise to any wide extent the scientific knowledge which is already available for them, apart altogether from the penetration of science into the new fields of social research The laxity of scientific men generally in regard to the exposition of their results, the widespread use of jargon, the inability of many scientific workers to express themselves in concise and accurate English, are serious obstacles to the spread of scientific knowledge into the sphere of political action Even in industry, startling examples are often encountered of the indifference of the research worker to the reporting of his results in terms intelligible either to other scientific workers or those responsible for management The industrial worker often remains ignorant of, and amazingly indifferent to, the contrast between the meticulous accuracy of his experimental work and the careless and ambiguous manner in which he presents his results He does not appear to realise that lack of care at this point may vitiate his work as effectively as inaccuracy in the laboratory

In consequence of this neglect, besides the difficulty placed in the way of the assimilation of scientific investigations into industrial or social practice, the scientific worker adds to the burden of publications of which he is often the first to complain. Looseness of thought, and indifference to the accurate and correct use of words, are a prime cause of the redundancy noticeable in many scientific papers. Dr. H. Moore was undoubtedly justified in stressing this point in his presidential address last year to the Institute of Metals. There are few papers indeed which would not have gained both from a scientific and from a literary point of view by careful revision, the exclusion of all irrelevant matter and the choice of the simplest and fewest words to express the author's meaning. As Dr. Moore pointed out, a clear idea of what he is doing and why he is doing it is as essential to the research worker in writing his paper or report as it is in the conduct of his experiments. A command of terse pregnant English is a valuable possession to the writer of a scientific paper, and is worth much trouble and patience to acquire. One of the merits of abstracting work as carried out in the past under the Bureau of Chemical Abstracts and elsewhere has been the discipline it imposes on the abstractors in regard to conciseness and clarity. Apart from the knowledge the abstractor acquires of his science, it enforces precision of language which should be a great asset in the writing of papers in subsequent life, and should exemplify, to him at least, the way in which force and clarity are related to brevity.

Dr. Moore estimates that the length of a scientific paper might well be reduced by about twenty per cent in this way, with advantages both in clarity and in diminished printing and publishing costs; and this reasonable estimate is sufficiently large to indicate that the matter is one well worth close attention by scientific societies. One of the difficulties is, however, the lack of perspective which sometimes characterises scientific writers—a failure to see their topic in its true relation to the science as a whole, and a tendency to claim, for the normal or average, the fuller and more detailed treatment which should be the privilege of those few papers which describe some really outstanding achievement or advance.

This question of values cannot be evaded. It is essential in the investigator alike in planning, executing and describing his work. It is equally essential when we confront the large question of the rational treatment of the mass of scientific literature to-day and the most efficient distribution of the burden. To its absence must be attributed the duplication of abstracting work which still persists, in regard to chemical literature, despite the example of co-operation afforded by the Society of Chemical Industry and the Chemical Society for nearly ten years. That it is difficult to avoid overlap between different fields such as chemistry, entomology, physiology, physics and engineering, etc., is obvious, though even here co-operation is less difficult than is imagined by the superficial. The duplication within any one field such as is provided by the abstracts of the Society of Public Analysts or the Society of Dyers and Colourists, to cite only two examples, which merely re-issue in varied form and at a later date the substance of abstracts provided for the whole science or profession by the Bureau of Chemical Abstracts, is surely remediable. Powerful arguments might be addressed in favour of the State contributing towards the cost of scientific publications, but support is unlikely to be given before men of science themselves eliminate the duplication of effort to which we have referred.

The waste and duplication are not confined, however, to abstracting publications. The same confusion of thought is to be found in regard to other types of publication as a result of the sectionalism and excessive specialisation in which such a profession as chemistry abounds. Each group pursues its own interests and special requirements without regard to those fundamental needs which must be served if its own specialisation is even to be possible. The net result is an intolerable burden on the parent and more comprehensive societies, such as the Chemical Society, which is appreciably enhanced by the marked reluctance of the younger members of the profession to support such societies by actual membership as compared with a couple of decades or so ago.

Chemists are probably neither better nor worse than other scientific workers in these matters, but if they and other men of science tend to lament rather too freely the burden which membership of numerous societies or the cost of publications places upon them, they should remember that the remedy is largely within their own hands. The setting of their own house in order would be a sure way of establishing the confidence of the community in the capacity of scientific workers for the wider fields of social service now opening before them.

Two Historical Notes

By PROF E N DA C ANDRADE, University College, London

HUMPHRY DAVY'S EXPERIMENTS ON THE FRICTIONAL DEVELOPMENT OF HEAT

IN practically all textbooks on heat, certain experiments of Humphry Davy are cited as constituting early experimental proof of the dynamical theory of heat, and they are generally said, either directly or by implication, to be of major importance There is a certain amount of variety in the description of what these experiments were several authors (for example, Poynting and Thomson, Grimsehl, Loeb and Adams and Hoare) say that he rubbed the pieces of ice together in a vacuum, while others (for example, Edser and Preston) say that he performed the experiment in air, and afterwards carried it out *in vacuo* Now any physicist who contemplates repeating the experiment will, I think, at once be struck with the difficulty, if not impossibility, of carrying it out in such a way as to produce anything in the nature of a convincing result If the ice is covered with a film of water, the friction is so small that scarcely any work is done, while if it is really dry it is liable to stick In any case, to make the frictional heat appreciable, it is necessary to have a normal force holding the two surfaces together, and then one gets the well-known lowering of freezing point and consequent melting, if the surroundings are at the ice point, with all the possible dangers of regelation at the edges Again, the amount of work required to melt 1 gm of ice is very large the criterion is an extraordinarily insensitive one All these difficulties are, perhaps, sufficiently summarised in the fact that nobody, apparently, has ever tried to repeat the experiment, and I, for one, would not care to undertake it

It is, then, perhaps worth while pausing a moment to inquire just what Davy did, and in what circumstances The account of these and certain other experiments was the author's first contribution to science, and was published (in "Contributions to Physical and Medical Knowledge, principally from the West of England", edited by Thomas Beddoes, father of the poet Thomas Lovell Beddoes) early in 1799, when he was twenty years old The work was, then, presumably carried out when he was nineteen The first experiment described is directed to show that light is not an effect of heat, he held that he had proved experimentally that particles of iron can be heated to the melting point without giving out light! The second and third are the celebrated ice experiments

In the first of these, described in less than three hundred words, without any detail, Davy says that he fastened two pieces of ice by wires to two iron bars and that "by a peculiar mechanism" the ice was kept in violent friction for some minutes The pieces of ice "were almost entirely converted into water" which, strangely enough, was found to be at 35° "after remaining in an atmosphere at a lower temperature for some minutes", or, in other words, the friction of ice can raise water many degrees above the melting point! Even supposing that the stroke of the 'engine' was 5 cm, and that it executed 100 strokes a minute, and that the coefficient of friction was 0 5, this would mean, if for "some minutes" we read "ten minutes", that the force pressing the pieces of ice together would have to be equivalent to an additional pressure of about 4 atmospheres The whole experiment is fantastic This is said in no disrespect to Davy how could one expect an untrained boy in 1799 to carry out an experiment which even to-day would tax an experienced physicist, to say the least? No doubt the whole effect observed by Davy was due to conduction

The second experiment, the one in a vacuum, was not concerned with ice at all, but with the melting of wax The wax was apparently attached to a metal plate, against which rubbed a clockwork-driven wheel The clockwork stood on a piece of ice in which was cut a channel containing water, and the whole was under an exhausted bell-jar The argument was that if the heat required to melt the wax had passed from the ice to the clockwork, the water would have frozen As, however, the heat required to produce the rise of temperature observed in the clockwork amounted to but 12 calories, only 0 15 c c of water would have frozen in any event, which actually could not be observed by eye in a rough channel cut in a piece of ice The experiment proves nothing at all

I may be held to have spent too much time on a point which some may say is of historical interest only I hold, however, that it is very inadvisable that students should be taught to attach a fundamental importance, not to experiments crudely carried out, which were afterwards improved, but to experiments of which one probably cannot be carried out at all, while the other is so ill-designed as to prove nothing I am no denigrator, I do not think that it detracts from the greatness of Davy to point out that his first experiments, carried out when he was a country lad, were uncritical and lacked all quantitative basis It is time, however, that they ceased to be ranked with such convincing demonstrations as those of Rumford, and disappeared from the textbooks Or, if they are quoted, do let us have instructions as to how to melt two pieces of ice by rubbing them together in a vacuum

NEWTON'S EARLY NOTEBOOK

In the Isaac Newton Memorial Volume, produced in 1927 to commemorate the two hundredth anniversary of Newton's death, there was published for the first time the contents of an early notebook, compiled by Newton as a boy or young man The first part consists of a collection of rules and hints relating to drawing and painting (how to shade, how to enlarge a picture, to make a russet colour and so on) , of receipts for cements, baits and other odd things , of cures for certain troubles , and of tricks Prof David Eugene Smith, who edited this matter, attributes it to some time within the period 1655–58 and apparently takes it to have been compiled by Newton Prof Louis Trenchard More, in his life of Isaac Newton, published last year, comments "The most interesting, perhaps, of the items in this book, are those referring to drawing and the making of pigments, as they show the great interest he took in the art, and to the chemical and medicinal recipes which he jotted down"

This part of the notebook is, however, no collection of Newton's own, but is copied out from a book of receipts popular at the time, namely, John Bate's "The Mysteries of Nature and Art", of which the first edition was printed in 1634, and the third and last edition (a copy of which is in my possession) in 1654, shortly before the period to which we must attribute the part of the notebook in question With this edition I have checked off all Newton's rules for drawing and painting, and many of his odd receipts—in fact, everything down to and including "To ingrave on a flint" in Prof David Eugene Smith's reprint The small remainder of this part of Newton's notebook consists of a few medical prescriptions and conjuror's tricks, which he may have picked up while lodging with Mr Clark, the apothecary I have not been able to trace them

Another point of interest in Bate's book is that it contains full directions for making a water clock, which correspond to the account which Dr Stukeley* gives of the water clock undoubtedly made by Newton There is no doubt, then, that the "Mysteries of Nature and Art" was a book which young Newton freely consulted, and I conjecture that profounder historians than myself will find that it well repays study

I may add that I find it a little difficult to accept Prof Smith's attribution of date, 1655–58, for the first part of the notebook On the first page of the book is the inscription

ISAAC NEWTON HUNC LIBRUM
POSSIDET
TESTE
EDVARDO SECKER
PRET 2^{d} OB
1659

Now, while a boy might write his name in a notebook, with his signature witnessed, as a schoolboy joke, some time after purchase, he is very unlikely to put the price, in this particular instance 2½*d* , except at the date of purchase We know that Newton was very careful in his accounts of expenditure I think we must take it that this inscription was inserted when the notebook was bought, and gives the date of the first entries

* See Brewster's "Life of Sir Isaac Newton", vol 1, p 9 Louis Trenchard More, "Isaac Newton", p 12

Centenaries of Newcomb and Schiaparelli

SIMON NEWCOMB and Giovanni Virginio Schiaparelli were born within two days of one another, the former at Wallace, Nova Scotia, on March 12, 1835, and the latter at Savigliano, Piedmont, on March 14, and they died within a year of one another, Newcomb passing away on July 11, 1909, and Schiaparelli on July 4, 1910 Counting among their most distinguished contemporaries Lockyer, Huggins, Gill, Janssen, Loewy, Otto Struve, Auwers, Asaph Hall, Langley and Young, Schiaparelli was long regarded as the foremost of Italian astronomers, while Newcomb became to be recognised as the most eminent man of science in the United States

They devoted themselves to widely differing branches of astronomy Newcomb, as a member of the staff of the Naval Observatory, Washington, and as head of the "American Ephemeris and Nautical Almanac", during the course of forty years, contributed greatly to the advancement of gravitational astronomy, while Schiaparelli added immensely to the knowledge of meteors, comets and the planets Honours were bestowed on them by many societies and institutions , both were associates and medallists of the Royal Astronomical Society, both were foreign members of the Royal Society and foreign associates of the Paris Academy of Sciences, while Newcomb's connexion with the United States Navy was recognised by Congress granting him the rank of a rear-admiral.

Of Newcomb, many appreciations were written after his death in 1909, but the most fascinating record of his life is his own "Reminiscences of an Astronomer", published when he was sixty-eight years of age In this, when speaking of Cayley the mathematician, he said, "His life was that of a man moved to investigation by an uncontrollable impulse, the only sort of man whose work is destined to be imperishable" The remark might well apply to Newcomb himself, for when at the age of twenty-two years, after an unusual start in life—which had included two years' service under a quack doctor—he entered his own "world of sweetness and light" as a computer in the office of the "Nautical Almanac" at Cambridge, Mass, his genius found the avenue which was to lead him to the highest distinction

Of his work, his travels and his friendships of the years 1857–77, Newcomb gave an account in the early chapters in his "Reminiscences" "On September 15, 1877," he went on to say, "I took charge of the Nautical Almanac Office The change was one of the happiest in my life I was now in a position of recognised responsibility, where my recommendations met with the respect due to that responsibility, where I could make plans with the assurance of being able to carry them out " He was editor of the "American Ephemeris and Nautical Almanac" for twenty years, and his most valuable work for science was done in connexion with it It was this work which led to his being awarded the Copley Medal in 1890, and being elected a foreign associate of the Paris Academy of Sciences in 1895, in succession to Helmholtz

A devoted public servant and an indefatigable worker, Newcomb set an inspiring example to all with whom he came in contact, while, said Sir Robert Ball, "His habitual loftiness of thought, nobility of character, dignified courtesy and ever-ready helpfulness endeared him to his many friends on both sides of the Atlantic"

Schiaparelli was far more fortunate than Newcomb in his early environment, and at the age of nineteen years graduated from the University of Turin in engineering and architecture For a year or two he taught mathematics, but astronomy had already laid its hold upon him, and in the year that Newcomb began his work at Cambridge, Schiaparelli was able to enter the Berlin Observatory, then directed by Encke, and two years later secured a post at Pulkovo under the Struves Recalled to Italy in 1860 to become assistant to Carlini at the Brera Observatory, Milan, in September 1862 on the death of Carlini he was made director of the Observatory and this post he held for thirty-eight years

Schiaparelli's first year at Milan was marked by his discovery of the asteroid Hesperia Four years after becoming the director, he announced his discovery of the connexion between meteors and comets, and in 1873 he published his "Le Stelle Cadenti", declared by Lockyer to be one of the greatest contributions to the astronomical literature of the nineteenth century In 1877 he commenced his observations of Mars, in 1882 began the study of Mercury and Venus and between 1875 and 1899 made 11,000 measures of double stars Failing sight brought an end to his observations, and in 1900 he retired Among his later work was his book on the astronomy of the Old Testament, in the preparation of which he had examined the dates of 2,764 Babylonian documents which had been translated

Schiaparelli's views on the so-called 'canals' on Mars led to much controversy, and it is worth recalling that it was this which reawakened Lowell's interest in astronomy and led him to erect the Lowell Observatory, at Flagstaff, Arizona, where just five years ago the planet Pluto was discovered

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Modern Plastics

SOME criticism has been made of the word 'plastics' as applied to the industry which goes under this name to-day The word 'plastics' is usually associated with clay, putty or similar materials which can be worked and shaped by hand But 'plastics' has not, even in the past, been limited to materials which retain their plasticity Clay, having been moulded into shape while in a plastic condition, takes permanent form after baking, but the article in its permanent form is still classified in the 'plastics' group The bulk of the products of the plastics industry in its modern form may similarly be characterised—initially plastic, they are converted by heat and pressure into permanent forms.

Bayer in 1872 first announced that phenols would react chemically with formaldehyde, but beyond this fact little further attention was paid by him to the product Other workers investigated the reaction later, and Kleeberg in 1890 first discovered that it was not a pure product that was obtained, but a sticky viscous material Then technical men more commercially minded came into the field and started investigations One of the early patents was taken out by Luft in 1902, who described a horn-like material which could be turned and shaped into various articles He described it as artificial horn Others followed, but none of them appears to have made a material which was commercially useful, since they found no means of controlling the reaction or arriving at a reliable or satisfactory end-product

Certain firms in Great Britain and in the United States began to develop the condensation product in liquid form for varnish purposes, but not until Dr Baekeland turned his attention to this reaction was progress made Dr Baekeland announced his new discovery in 1908, and applied for patents in most countries in the world The basis of his invention consisted in the use of relatively small proportions of ammonia as an accelerator in the reaction between phenol and formaldehyde, as against large amounts of acid or alkali used hitherto He found that by the use of a small amount of alkali, the reaction could be controlled and checked at a convenient point during its progress, this resulting in an intermediate product between the raw materials and the final end-product obtained previously, which was hard, brittle and non-plastic

All previous workers on this product had obtained a crystalline product or a hardened mass which was of little value Dr Baekeland succeeded in producing a material which could be used commercially It could be readily handled, being a resin-like solid which could be ground, powdered, softened or dissolved in solvents This he termed Bakelite 'A' This product was chemically changed on the application of heat by polymerisation into a permanently hard amber-like solid which would no longer soften by heat, had good insulating properties and was termed Bakelite 'C' When mixed with fillers in a powdered state, it could be introduced into steel moulds, subjected to heat and pressure in hydraulic presses, and, by continued application of heat, it set solid and assumed the shape or the contour of the mould into which it had been pressed, and could be discharged permanently solid This process is the basis of the modern plastic moulding industry to-day

The early material of Dr Baekeland's invention was somewhat variable in quality and slow in its rate of hardening in the mould to the 'C' stage, and consequently the moulding industry made slow headway. It was in a very elementary stage, and it was not until towards the end of the War that practical advancement in the technique of manufacture of what are now termed the resinoid moulding powders, showed any progress in Great Britain The last fifteen years has brought about considerable change in the industry and its technique. Where twenty-five years ago the moulding materials consisted of the resin A, ground to powder and mixed with dye and wood-meal, of which the rate of hardening was 5–15 minutes for an article of relatively small size, to-day similar articles are turned out from complex moulding mixtures at the rate of 1–1½ minutes in multiple impression moulds having as many as 50–75 impressions, so that where one article was produced in five minutes, we have to-day 200–250 of the same articles turned out in the same time

The production of mouldings has been referred to as illustrating the advancement of one side of the resinoid plastics industry Dr Baekeland's invention led to the production of other useful materials, apart from mouldings for the electrical and allied industries It was found that, when this Bakelite Resinoid A was dissolved in solvents, and paper sheets were impregnated with it and then dried and pressed together in a hydraulic press between steam-heated platens, the resinoid hardened and made a compact mass consisting of laminations of paper sealed together by the hardened resinoid, the product was 'Bakelite laminated sheets' This material was found to be very hard and tough, yet it could be machined and had excellent insulating properties It found a ready application in the electrical industry The advancement in this branch of the industry has been less spectacular than in the moulding section, but advances have been made The methods employed in production to-day are very much the same as when this material was originally introduced, apart from minor improvements in plant, but I feel sure we can look for great advances in methods of production, cheapening in costs and widening its applications

Until the last year or two, the production of mouldings had been confined to small articles chiefly for the electrical industry, such as switch cover plates, distributor heads for car ignition sets and picnic set requisites and many similar products With the introduction of radio sets at a price to attract the masses, the question of the production of cabinets to house the sets was considered by those concerns which turned their attention to the production of such sets in large quantities in standard and uniform design It then became evident that a case or housing for such sets could be produced in plastics more fitting in design to meet modern requirements at prices to compete with those constructed of wood This led to the production of the moulded radio cabinet, of which there are many examples to be seen to-day. The production of these cabinets called for the installation of very large and expensive hydraulic presses and moulds costing several thousands of pounds. The very existence of these presses will, no doubt, have the effect of leading the industry into the production of larger mouldings. The general tendency will be towards the production of still larger articles in moulded plastics, each moulding requiring many pounds of powder, thus gradually supplanting many articles and parts of articles at present made in wood or metal by plastic moulded articles made on mass production lines When this comes about, it is obvious that designs will have to change to meet the modern technique of production

Very serious artistic thought should be given to the designs for the future, in order that such production may not only be practical from a mass production point of view, but also both restful and pleasing to the eye in outline and colour In that way they will establish for themselves a permanent future and not be just a 'five minute wonder' to die out for lack of permanent artistic foundation This is a point to which the industry should pay attention if it desires to establish itself as one of the main industries of the future

The laminated material referred to above is at present relatively new compared with the moulding industry Its chief applications have been industrial, in so far that it has formed a part in a main assembly, that is, in its use for insulation purposes in electrical equipment Now, however, the material can be produced in sheets of larger sizes and in various colours and finishes, and it is already finding a use in industries that cater for domestic requirements The laminated sheet material has some valuable features as it is resistant to heat, not readily marked or scratched, unaffected by alcohol and other solvents, and can be highly polished Such properties are of value for many domestic applications It is used for tops of tables in cafés, for dressing-table tops in hotels In the United States it has been tried out as panelling for ships, state-rooms, cocktail bars , and similar applications are under trial in Great Britain There are many uses for this material not yet developed, as it is difficult to find any other class of product which exhibits similar properties There is no doubt that we shall see large developments in its use during the next few years When sheets of this product are available in pleasing soft colours, they are likely to find favour for room decoration, for which, in many ways, they are ideal

Future designs will require careful thought and planning Present ideas do not entirely fit in with production of this type of material, and a new art and technique will have to be developed to meet these new products Many articles which were previously made by hand, in many cases elaborately decorated by the craftsman, will in the future be produced in mass by this new process of moulding and fashioning For a time, the craftsman's hand on the finished article will disappear until the industry has so advanced its technique that present difficulties of production have disappeared , then, there will be room for the craftsman to exercise his art—not on the finished article or on its construction, but in the steel or other material forming the master model from which such articles will be produced, and by engraving into it pleasing designs and artistic ideas which will be effectively and correctly reproduced in detail on the moulded articles By these modern processes, such articles will be manufactured in quantities which will enable them to be sold at prices within the purchasing capacity of the majority

H V POTTER

Obituary

DR R C. KNIGHT

SCIENTIFIC horticulture has suffered a heavy loss by the death on January 28 of Dr R C Knight, assistant director of the East Malling Research Station He was born in 1891 and was educated at Sexey's School, Bruton, Somerset, and at the University of Bristol, where he took a degree in botany He obtained a Board of Agriculture research scholarship in plant physiology in 1916, which he held at the Imperial College of Science and Technology, and in 1919 he was appointed to the staff of the Research Institute of Plant Physiology of that College His association with East Malling Research Station began in 1920, when the demonstration of striking examples of rootstock influence upon the scion opened up a promising field for physiological investigations. At first Dr Knight merely visited the Station for short periods to familiarise himself with his problems and to collect the necessary material By 1922 it became obvious that in order to push forward with the work he must live on the spot with his material, and he was seconded for duty at the East Malling Station, where he worked until his death.

So wide were Knight's interests that he rapidly became familiar with the horticultural problems being investigated around him, and although he often said that these early years were "spent in closing doors by obtaining negative results rather than in opening them", this was an essential preliminary exploration, and he was all the time evolving in his mind and discussing with his colleagues those 'physio pomological' methods which he used so much in later years While he did much careful work in determining the optimum conditions for raising hard-wood and soft wood cuttings, his outstanding contribution was concerned with the practice of layering Here he emphasised and elucidated the all-important part played by the etiolation of the base of the shoot in encouraging adventitious rooting By directing attention to this aspect he made it possible to reproduce with much greater certainty clonal races of a far wider range of plants than had been possible heretofore

Knight's contribution to horticultural science, however, is in no way measured by the twenty or more published reports standing under his name He exercised a profoundly stimulating influence not only upon his immediate colleagues, but also upon the large number of graduate workers and investigators on leave from overseas who visited the Research Station for long or short periods

Much of Knight's thought and care is built into the structure and equipment of the laboratories and library, but after these are forgotten his informal methods of evoking stimulating discussion, his unobtrusive readiness to give good counsel and frank criticism, and his gift for inspiring confidence will long be remembered by his colleagues

DR HERBERT WELD

We regret to record the death at the age of eighty-three years of Dr Herbert Weld, geographer and archæologist, which took place at Lulworth Castle, Dorset, on February 4

Dr Weld was best known as an authority on the history and geography of Abyssinia, parts of which country he was the first to map Of recent years, however, his name has more frequently been before the public in connexion with the exploration of Kish in Iraq by the Oxford University Expedition under Prof S Langdon, for which he was responsible, obtaining the concession at Tell Aheimar while in Iraq in 1922, and financing the expedition, which began operations in the following year In addition to a large number of antiquities and an invaluable store of archæological data going back to the earliest stages of human occupation of the country, the expedition acquired some thousands of inscribed tablets These, with such of the antiquities as were allotted to the expedition, were presented to the Ashmolean Museum at Oxford

Herbert Weld (formerly Weld Blundell) was the son of Thomas Weld-Blundell of Ince Blundell, and was educated at Stonyhurst and Queen's College, Oxford, from which university he afterwards received the honorary degree of D Litt in recognition of his work in connexion with the expedition to Kish Before his exploratory work in Abyssinia he had already travelled in Persia (1891), Libya (1894), where he visited all the oases in turn, and Cyrenaica (1895) While in Persia he visited Persepolis and took a number of moulds of the reliefs, which he presented to the British Museum and the Louvre. He also prepared a scheme of restoration which was eventually utilised His first visit to Abyssinia took place in 1898–99, when he travelled from Somaliland to the Sudan, bringing back a large collection of birds, including seventeen new species, which he presented to the British Museum (Natural History) In 1905, after the interruption of the South African war, where he was present as a newspaper correspondent, he was again in Abyssinia, continuing his work of mapping and collecting. On this occasion he covered the previously unmapped course of the Blue Nile from Tsana to the Sudan He had already been a contributor to the *Geographical Journal*, the "Annual" of the British School at Athens and the *Journal of the African Society*, when in 1923 his Abyssinian studies bore further fruit in a highly valued volume, "The Royal Chronicle of Abyssinia, 1769–1840", of which the text, in translation from the "Ethiopic Chronicle" in the British Museum, was accompanied by learned and informative appendixes.

PROF R A ROBERTSON

Robert Alexander Robertson, born in Rattray, Perthshire, in 1873, was a graduate in arts and in science of the University of Edinburgh Going to the University of St Andrews in 1889, he was appointed lecturer in botany in 1891, his status being raised to that of reader in 1915 In 1920 a chair of botany was instituted and Prof Robertson became its first occupant He retired in September 1934, and died on January 15 last

Robertson was a great teacher Not only had he the power of imparting knowledge, but he also developed initiative and created enthusiasm In his early years at St Andrews he provided many examples from the vegetable kingdom to illustrate the then new conception of 'functional inertia' advanced by Fraser Harris In those days, too, recognition of timbers by their microscopic structure was pioneer work when illustrated by microphotographs

Prof Robertson was a fellow of the Royal Society of Edinburgh and of the Linnean Society He was a fellow of the Botanical Society of Edinburgh and its president in 1915 He was elected to the committee of management of the Imperial Bureau of Mycology from its inception in 1922 Prof Robertson commanded the St Andrews contingent of the O T C from 1912 until 1922

A man of great sympathy and of high principle, Prof Robertson strove in all things to do that which was best In this creed he gave forty-four years of strenuous service to his adopted University, and devoted a life to the advancement of botany in Scotland

Prof Basil Hall Chamberlain, emeritus professor of Japanese and philology in the University of Tokyo, died at Geneva on February 15 at the age of eighty-four years At the time of his retirement from the University of Tokyo in 1905, he was widely recognised as one of the first authorities on the life and culture of the Japanese, avoiding the sentimentality and false idealisation which characterised most writers on the country of his day

We regret to announce the following deaths.

Sir Leslie Mackenzie, medical member of the Scottish Board of Health from 1919 until 1928, and president of the Geographical Association in 1931–32, on February 28, aged seventy-two years

Sir William Morris, superintendent of the Ordnance Survey of the Transvaal and Orange River Colony in 1902–7, on February 26, aged eighty-eight years.

News and Views

New Fellows of the Royal Society

THE Council of the Royal Society has agreed to recommend for election into the Society the following seventeen candidates Dr N K Adam, research chemist, University College, London ; Prof E N. da C Andrade, Quain professor of physics, University of London ; Sir Frederick Banting, professor of medical research, University of Toronto , Prof S P Bedson, Goldsmiths' Company's professor of bacteriology, London Hospital Medical School , Mr E. J Bowen, fellow of University College, Oxford , Mr G E. Briggs, lecturer in plant physiology, University of Cambridge ; Prof H Graham Cannon, professor of zoology, University of Manchester , Prof W E le Gros Clark, Dr Lee's professor of anatomy, University of Oxford ; Prof J S Foster, professor of physics, McGill University, Montreal , Dr A. L. Hall, lately assistant director of the Geological Survey of the Union of South Africa , Dr W H Hatfield, Brown-Firth Research Laboratory, Sheffield , Dr J de Graaff Hunter, lately of the Survey of India ; Dr B A Keen, Rothamsted Experimental Station ; Prof. R A. Peters, Whitley professor of biochemistry, University of Oxford , Prof J. Read, professor of chemistry, University of St Andrews ; Dr R N. Salaman, director of the Potato Virus Research Station, Cambridge ; Dr R Stoneley, lecturer in mathematics, University of Cambridge.

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 4, the following ordinary fellows were elected Dr J L Brownlie, chief medical officer, Department of Health for Scotland ; Dr R S Clark, scientific superintendent, Fishery Board for Scotland , Lieut -Col S H Cowan, lecturer in forestry engineering, University of Edinburgh , Mr C F. Davidson, geologist, H M Geological Survey of Great Britain , Mr Maxwell Davidson, lecturer in heat engines and thermodynamics, University of Edinburgh , Dr B N. Desai, assistant meteorologist, Government of India ; Dr R. Grant, demonstrator, Zoology Department, University of Leeds , Dr A M M. Grierson, senior assistant medical officer of health, Manchester , Dr A C. W. Hutchinson, dean of the Edinburgh Dental Hospital and School ; Dr J H Kenneth, assistant, Imperial Bureau of Animal Genetics, University of Edinburgh , Prof. Peter MacCallum, Pathology Department, University of Melbourne, Australia ; Dr. W. A. Mozley, Walter Rathbone Bacon scholar, Smithsonian Institution, 1931–34, Department of Zoology, University of Edinburgh ; Mr. J. Munnoch, formerly controller, General Post Office, Edinburgh ; Dr. B. Narayana, lecturer in physiology, University of Patna, India ; Mr C. S. Pichamuthu, assistant professor of geology, University of Mysore, India ; Mr. T. Rowatt, director, Royal Scottish Museum, Edinburgh ; Prof. M. G. Say, Department of Electrical Engineering, Heriot-Watt College, Edinburgh ; Mr Eric Stevenson, lecturer in Engineering, University of Edinburgh , Dr J D Sutherland, lecturer in psychology, University of Edinburgh , Mr J E Touche, Edinburgh , Sir William Whyte, solicitor, Uddingston

Sir C. V. Boys, F R S.

ON Thursday next, March 14, Sir C V Boys—more familiarly known as Prof Boys, though the honour of knighthood was conferred upon him by H M The King at the beginning of this year—will be eighty years of age , and his friends everywhere will, we are sure, be glad to associate themselves with us in offering him a tribute of esteem and congratulation on this event The Royal Society Club, of which Boys is the senior member, is to celebrate the occasion with a festival dinner, at which he will be presented with an album containing the autographs of members of the Club The Club consists of a group of fellows of the Royal Society who dine together on the days of the ordinary meetings It was formed so long ago as 1743, and its history has been related in a substantial volume by Sir Archibald Geikie entitled "Annals of the Royal Society Club", published in 1917 Benjamin Franklin was very frequently among the visitors in the latter half of the eighteenth century , and it is particularly appropriate to recall this association with the Club of the discoverer of the nature of lightning, and the recent work of Boys in the same field

SINCE 1752, when Franklin proved that lightning was an electrical discharge, and concluded that "for the most part, in thunderstrokes it is the earth that strikes into the clouds, and not the clouds that strike into the earth", practically no experimental work on the subject had been done until our new Franklin devised his rotating lens camera for the study of the propagation of the discharge Boys gave the first description of this ingenious instrument in an article entitled "Progressive Lightning" in NATURE of November 20, 1926 (118, 749), and its use in South Africa by Dr E. C Halliday, Dr B J F Schonland and Mr H Collens has shown that the majority of the lightning strokes examined consist of a dart-like downward-moving leader stroke, which may be described as an electron avalanche, followed immediately upon arrival at the ground by a more intense upward moving main stroke along thermally ionised channels. The device by which this new knowledge has been secured represents, like Boys's gas calorimeter, the production and use of quartz fibres for the determination of the gravitational constant and other purposes, the photography of rifle bullets and the study of soap bubbles, the application of most original conceptions to experimental inquiry. It may be trite to say that whatever subject Boys has touched he has adorned, but it is certainly true that his contributions to classical experimental physics will go down in the history of science among the highest achievements of a brilliant period.

T. O. Bergman (1735–84)

Torbern Olof Bergman was born at Katrineberg, Vestergotland, on March 10, 1735 Educated at Uppsala, he first taught mathematics and physics at the University there, before becoming professor of chemistry and mineralogy in 1767 He greatly improved upon the early technique of blowpipe and 'wet' methods of analysis His most important contribution to theoretical chemistry was his "Essay on Elective Attractions", that is, on chemical affinity For many years he endeavoured to determine the numerical values for the relative affinities of the elements, bases and acids, but his results were of little significance, since no account was taken of such factors as mass action and the volatility, insolubility, etc of some of the products of chemical reactions In the course of his investigations, Bergman discovered the elements molybdenum and tungsten, but it was said of him that "his greatest discovery was Scheele"

Medal Awards of the Institution of Chemical Engineers

At the thirteenth annual corporate meeting of the Institution of Chemical Engineers held on February 22, the Moulton Medal, the Junior Moulton Medal and Prize of books, and the Osborne Reynolds Medal were presented. These awards were instituted in 1929. The Moulton Medal, which commemorates the chemical engineering work of the late Lord Moulton at the Department of Explosives Supply, is in gold and bears on the obverse a portrait of Lord Moulton, and on the reverse, the seal of the Institution It is awarded for the best paper of each year presented before the Institution Papers by non members are eligible for this Medal The award for 1934 was made for a paper by Mr J Davidson Pratt and Mr G. S W Marlow, entitled "Legal Pitfalls for the Chemical Engineer" The Junior Moulton Medal is in silver, and is a duplicate of the senior award It is given for the best paper of the year read before the Graduates' and Students' Section of the Institution Only papers by graduates and students of the Institution are eligible for this Medal and Prize The 1934 award was made for the paper "Determination of the Efficiency of a Multi-Stage Washer", by Mr D Gordon Bagg The Osborne Reynolds Medal, in silver, commemorates the fundamental investigations of the late Prof Osborne Reynolds, and is the gift to the Institution of Mr F. A Greene, the honorary treasurer It bears on the obverse the seal of the Institution, and is awarded for meritorious service for the advancement of the Institution For 1934 the award was made to Mr H J Pooley, in recognition of his work as honorary director of the Appointments Bureau of the Institution since the inception of this office in 1925

New President of the Society of Chemical Industry

Mr W. A. S Calder, delegate director of the General Chemicals Group of Imperial Chemical Industries, Ltd , has been elected president of the Society of Chemical Industry for the year 1935–36. Mr. Calder's lifelong association with the chemical industry commenced after he left the Royal College of Science and joined the staff of Messrs F C Hills and Co , of Deptford In 1899 he became head chemist and manager of Messrs Chance and Hunt at Oldbury, of which firm (now part of Imperial Chemical Industries, Ltd) he became managing director in 1917 When the works were taken over by the Ministry of Munitions during the War, in addition to an increased output of acids and heavy chemicals, an important installation for the manufacture of T N T was developed under Mr Calder's direction Mr Calder is a former president of the Institution of Chemical Engineers, and has always taken an active part in the administration of that organisation and is a member of the executive board of the Chemical and Allied Employers Federation He is the co-inventor with Dr C C Fox of the Calder-Fox scrubber for the removal of liquid and solid particles from gases

Malthus Commemoration

Thomas Robert Malthus, the economist, author of the "Essay on the Principle of Population", died a hundred years ago on December 23, 1834, and the centenary was celebrated in Cambridge on March 2 Many distinguished economists and statisticians met in King's College, along with a few biologists who came to mark the influence of Malthus upon Darwin and his 'struggle for existence'. Prof A C Pigou presided, and addresses were delivered by Mr. C R. Fay, Mr J M Keynes, and by Dr James Bonar, whose book on "Malthus and his Work", written just fifty years ago, remains our chief authority The same company met again at dinner in Jesus College, of which Malthus was undergraduate and fellow The Master, Mr Arthur Gray, spoke to the memory of Malthus, and beside him sat the one surviving kinsman of the philosopher Dr Gray coupled the toast with Dr James Bonar's name, and charmed all his hearers with a simple, intimate account of Malthus and his friends, of the influence which Malthus exercised, and the events and circumstances which influenced him Malthus became professor of political economy at Haileybury, and was the first of all professors of that science ; he was one of the early members of the Political Economy Club, together with Tooke, Ricardo and James Mill , and at the very end of his life he was one of the founders of the Statistical Society Mr Gray had many interesting things to say of David Hartley the philosopher, also a member of his College, whose "Observations on Man" and other writings had great influence on the political philosophy of the latter half of the eighteenth century Malthus and Coleridge (yet another Jesus man), both born after Hartley died, were in their several ways both deeply indebted to him. Coleridge wrote of him as "Hartley, of mortal kind Wisest", and called his son after his name. Hartley Coleridge was born all but fifty years after David Hartley died, and just two years before the "Essay on Population" appeared. Samuel Taylor Coleridge and Thomas Robert Malthus died in the same year, 1834.

The Pace of Progress

IN his Rede lecture at Cambridge on March 4, Sir Daniel Hall discussed the way in which State control is tending to retard the rate of material progress based upon science, and the effect of this tendency on scientific life and thought From the re-birth of science at the Renaissance, the time-span of social and technical progress has steadily diminished The two centuries between the invention of printing and the foundation of the Royal Society, the hundred and forty years from that time to the close of the eighteenth century, the first ninety years of the nineteenth century, and the last forty years can be regarded as a series of diminishing time-spans of approximately equal material advance Material progress which formerly was spread over several generations now occurs within a single lifetime, and our social economy is correspondingly disturbed This disturbance is the greater because of the persistence of a social structure developed when agriculture was the dominant as well as the primary industry of mankind Agriculture is at present the outstanding example of an industry brought to an economic standstill because of our inability to handle the enhanced powers of production due to science The theory of over-production, however, postulates a static society and an inelastic demand, and the disturbing effect of science in the form of invention and discovery is enhanced by greater efficiency, made possible through advances in the technique of organisation

SIR DANIEL HALL suggested that the difficulty of adjusting the pace of increased production to the social structure first became apparent in agriculture, and that the failure of peasant farming to stand up to the competition of mechanised farming in America and the newer countries was the fundamental factor in determining the shift of fiscal policies in Europe from 1870 onwards The initial aim of these policies in Europe was to preserve the fundamental peasant basis of each State and to check the rate of material change The policy of national self-sufficiency pursued by such different methods, for example, as in the Irish Free State and in Italy or Germany, has essentially the same object, and commences by lowering the standard of living as the inevitable consequence of excluding imported goods In contrast to countries which are content to forego material advantages promised by scientific progress and to accept a low standard of living as the price of national unity and sufficiency, the equally isolated Russian State embraces science as the means of creating real wealth which can be shared among all its population and definitely seeks to raise the standard of living This system also presupposes a closed autocracy in which it is doubtful whether science can continue to grow or be required, and Sir Daniel suggests that the Marketing Boards now being tried in Great Britain, while an alternative to these two types of autocracy, equally eliminate individual enterprise and threaten to damp the fire of research. Science is an extinguishable response to man's inherent curiosity and its course needs to be broadened not arrested, so that science serves the majority and not merely the interests of a few

Scientific Developments and Defence Against Air Attacks

THE Under-Secretary of State for Air, Sir Philip Sassoon, announced in the House of Commons recently that a special committee has been set up to investigate the possibilities of countering air attacks by utilising recent progress in scientific invention The committee, which is already at work, consists of Mr H T Tizard, rector of the Imperial College of Science and Technology (chairman), Prof A V Hill, Foulerton research professor of the Royal Society, Prof P M S Blackett, professor of physics at Birkbeck College, University of London, and Mr H E Wimperis, Director of Scientific Research, Air Ministry It will be seen that, with the exception of the last named, the committee's composition is non-official, and Sir Philip paid tribute to the public spirit which has induced these gentlemen to give their services He also stated that while the body has been kept small to facilitate rapid progress, it is intended to invite other distinguished men of science to contribute to its investigations, and that its actual membership may be enlarged if and when it appears necessary Prof. F A Lindemann, professor of experimental philosophy in the University of Oxford, has already been invited to assist, in view of the attention that he has given to the subject It is intended to bring the committee's report before the Committee of Imperial Defence in due course

Radcliffe Telescope for University of London Observatory

OXFORD, both University and the City, is witnessing now the first results of the legal decision upholding the rights of the Radcliffe Trustees to act in the best interests of Urania This duty led them in the most obvious way possible to a happier clime, where clear skies with steady seeing occur with far more frequency than in Oxford Quite soon the quaint but beautiful Radcliffe Observatory will cease to adorn the Woodstock Road, and Pretoria will glory in its opportunity to cherish the Radcliffe 72 inch reflector now under construction at Newcastle-on-Tyne Of late, the Trustees have been engaged in finding new domiciles for such instruments as are not required in South Africa, and to this end offered to the University of London as a free gift the most valuable of the telescopes This is one of the finest examples of the skill of the late Sir Howard Grubb It comprises a photographic refractor 24 inches in diameter and 270 inches in focal length, with a visual refractor 18 inches in diameter and 270 inches in focal length The Senate of the University of London has accepted this magnificent gift for its observatory at Mill Hill, where for the last five years in a conspicuous building of attractive design an enthusiastic group has worked This notable addition to the facilities of the Observatory is a fitting reward for much labour, in that it will provide further and extended opportunities for investigation which will no doubt be fully utilised.

Birth of a Chimpanzee at the London Zoo

THE birth of a chimpanzee, at the Gardens of the Zoological Society of London on February 15, is an event worthy of record, and it shows, in no uncertain way, how carefully the well-being of the great apes is studied at the Gardens. The mother, and her daughter, we are told, are doing well. Dr. Wyatt, of St. Thomas's Hospital, and Dr. G. M. Vevers, a member of the staff of the Society, missed no opportunity of studying all the phases of pregnancy, from the time that it was detected until the birth took place. The period of gestation was 250 days. The period of labour Dr. Wyatt describes as precisely similar to that of the human being. A detailed account of the birth is to be given in the next issue of the *Proceedings* of the Society. A deficiency of calcium being suspected, the prospective mother was given regular supplies of 'Micklefield irradiated milk'. This is prepared by passing fresh milk, in a thin film, under ultra-violet rays, a process which results in an increase of the vitamin D content of the milk, thus making the lime salts in it more easily assimilated.

Fertility of the Earth

IN his Research and Development Lecture delivered under the auspices of the Royal Institution and the British Science Guild at the Royal Institution on March 6, Sir Frederick Keeble spoke on the fertility of the earth. Soil fertility is a product—a by-product—of the bacteria and other microscopic forms of life that teem in incredible numbers in the soil. The crops grown in field and meadow serve mankind in two ways. On one hand, they supply substance for making blood, bone, flesh and sinew and for providing energy for the work of life. On the other hand, they supply substances which stir up the body to activity so that it can use the foods for building purposes and for supplies of energy. Therefore the most important task that agricultural science can accomplish is to discover and learn to control the conditions in which soil and crop provide both the necessary body-building and energy-yielding food materials and also those that stir up growth and activity in the animal and human body. Much is known of the conditions necessary for the production of the first kinds of food. But little is known about the conditions under which crops provide the growth- and activity-provoking foods. When this is understood, foods will be judged by a new and higher standard than they are at present, and with foods conforming to that standard, human strength will increase and health will improve.

Maiden Castle, Dorchester

DR. R. E. MORTIMER WHEELER's account of his excavations at Maiden Castle, Dorchester, presented to the Society of Antiquaries of London on February 28, and his report in *The Times* of March 1, make possible a judicial estimate of the importance of this remarkable site in the prehistory of south-western Britain on more assured evidence than size alone, impressive though this may be. As Dr. Wheeler points out, Maiden Castle stands at the centre of an area noteworthy for the number of its sites of prehistoric occupation. It is clear that its history must be that of a pivotal point in cultural and social development. On the evidence afforded by the first season's exploration, four periods of occupation have been differentiated. Of these the earliest, surprisingly enough, was found to date back to the stone age—an occupation by a neolithic people, pastoralists, keeping sheep, pigs and a large breed of ox which had become extinct by historic times. They were pit dwellers and makers of pottery of the 'Windmill Hill' type. This settlement is dated tentatively at 2,000 B.C. Of the later occupations two are pre- and one late-Roman. In the early Iron Age, towards its end, possibly about the fourth century B.C., a site of about fifteen acres was enclosed by ditch, rampart and palisade. The extension of the area to its present size of about a hundred acres, with its complicated series of defences, is perhaps to be attributed to the next period of settlement, but this is not yet clear. It was in this period in the second century B.C. that peoples from Brittany, with their Celtic craftsmanship, spread over the Somerset plain, reaching Glastonbury and Meare. At Maiden Castle, however, Dr. Wheeler has as yet discerned no fundamental change in the character of the population. Towards the close of the period of Roman occupation the site, which for a time had been left derelict while the neighbouring Roman town of Dorchester was flourishing, was reoccupied and the building took place of the now famous Romano-British temple which Dr. Wheeler has rediscovered.

Kalevala Centenary

ON February 28, the Finnish people celebrated the centenary of the completion by Elias Lönnrott of the first edition of the *Kalevala*, the Finnish national folk-epic. The celebrations culminated in a great gathering in the recently completed Fair Hall at Helsingfors, at which a large number of scholars and delegates from foreign countries were present. Great Britain was represented by Mr. Robert Nichols, Dr. Margaret Murray (Royal Anthropological Institute) and Miss Agnes Dawson (Folk-Lore Society). It was at one time the fashion to compare the *Kalevala* with the Homeric poems; but in fact this great collection of the legends and folk-lore of Finland is unique in European literature, both as a picture on an enormous canvas of a very primitive stage of society and as a mosaic of pagan magic, pagan religious belief and heroic legend. In this respect it surpasses anything that can be found in the pagan element of Germanic or Scandinavian saga. It consists of a large number of ballads which Lönnrott collected among the peasantry of Karelia, the eastern province of Finland, and wove into a composite whole. It has played an important part in fostering Finnish national aspirations, and has been a fertile source of inspiration in literature, art and music. Since Lönnrott's day much further material of a similar character has been collected. The esteem in which this body of literature is held as a national possession was marked in the present celebrations by a special session of the Diet at which a sum of approximately £9,000 was voted for the further study of the ancient history, culture and literature of the Finnish people, and by the presence of more than 4,000 people when M Mantere, Minister of Education, opened an exhibition, at which a large collection of pictures by Gallen Kalicia, Finland's greatest painter of Kalevala subjects, was the centre of attraction

Training the Industrial Chemist

THE important subject of the training of an industrial chemist was discussed by Mr Thomas Donaldson in his address as chairman of the Glasgow Section of the Society of Chemical Industry at a meeting held jointly with the Glasgow Section of the Institute of Chemistry in the Royal Technical College, Glasgow, on March 1 Mr Donaldson is general technical manager of the Explosives Group of Imperial Chemical Industries, Ltd, and though he made it clear that he was expressing his own personal opinions, his long industrial experience and his position as a governor of the Royal Technical College give him an opportunity of forming an unbiased opinion by being able to look at the problem from both sides His chief criticism of the present system is that the training usually considered necessary to equip a man for chemical industry is too long In Scottish universities a student of chemistry takes an honours degree requiring four years study and then normally pursues research leading to a doctorate This research period extends over three years for a Ph.D and then, at the age of about twenty-four years, the man endeavours to obtain an industrial position Once in industry, it requires a further two years training before the man can be considered to be a thoroughly efficient member of his profession, since the university training has scarcely touched on industrial chemistry Mr. Donaldson suggested that instead of the present system a man should take a three years pass degree, and he could then decide whether he would continue to pursue a technical career If not, then, by two years training on the commercial side, he could become a thoroughly efficient technical salesman If he decided to remain on the technical side he had two alternatives. He could complete his honours degree and do one year's post-graduate research, or he could take a two years course in applied chemistry On this matter of starting research, Mr Donaldson said that it is far more important that students should be trained in the methods of research rather than that they should solve any particular problem

Annual General Meeting of the Institute of Chemistry

AT the fifty-seventh annual general meeting of the Institute of Chemistry held on March 1, Prof. Jocelyn Thorpe (president), in moving the adoption of the annual report, said that the register of the Institute now contains the names of 6,285 fellows and associates and more than 800 registered students. The Institute is in a strong position financially, and has co-operated with many other organisations in matters of public importance during the year Negotiations are on foot for closer co operation with other societies devoted to chemistry, particularly the Chemical Society and the Society of Chemical Industry Continuing, Prof Thorpe dealt with the importance of individualism in professional scientific life Having regard to the bearing of the subject on the development of team work in research, he emphasised especially the desirability of giving due credit to the individual worker who initiated and developed ideas He contrasted the present conditions for research work with those existing some forty years ago in the big German factories, where there was little or no intercourse between the members of the research section, who never seemed to talk to one another, being fearful lest they should communicate to their fellow-workers something of the investigations on which they had been engaged, and thus lose the credit due to themselves This competitive method has now practically died out The following were elected officers of the Institute for the ensuing year *President*, Prof Jocelyn Thorpe; *Vice-Presidents*, Mr W J A Butterfield, Sir George Clayton, Dr A E Dunstan, Mr F G Edmed, Dr H H Hodgson, Mr W H Roberts, *Hon Treasurer*, Mr P H Kirkaldy

Training in Food Technology

IN NATURE of February 23, we summarised the proceedings at a meeting held under the auspices of the Food Group of the Society of Chemical Industry, to discuss a paper on this subject by Dr. H B Cronshaw, editor of *Food Manufacture*, the *Manufacturing Chemist* (*not* the *Industrial Chemist*, as erroneously stated in the notice), the *Food Industries Weekly*, etc Dr Cronshaw writes to us to make clear that he was advocating an extension, rather than a restriction, of the food chemist's general scientific training, particularly in pre-graduate days, in the direction of physical chemistry and of biology (including bacteriology), this is not in any way inconsistent with increased technological facilities, both in teaching and in research, at the post-graduate stage He is in agreement with his fellow-members of the Food Group that the food technologist must be a scientific worker first and foremost

German Physical Congress

THE *Physikalische Zeitschrift* of December 1, 1934, contains the communications and discussions made to the German Conference of Physics held in Pyrmont last September The section on low temperatures includes reports on the magnetic method for attaining low temperatures, on supra conductivity, on the calorimetric behaviour of metals at low temperatures, on reflection of light and photo electric effect at low temperatures, etc The other section on atomic and nuclear physics includes communications on absorption lines, discharge tubes, molecular oscillations in sound-wave phenomena, positrons, cosmic particles, and electron optics, etc

European Bison in Poland

A RECENT Quarterly Information Bulletin concerning the protection of Nature in Poland records that the herd of bisons living in the forest of Bialowicza has now reached the number of fourteen individuals, of which nine belong to the pure race These are two adult males, two young males, two adult females and three young ones The remaining five are hybrids—the fourth generation of a cross between an American bison cow and a European bison bull Of the present stock, five individuals were bought in 1929, and the remainder were born in Bialowicza, as well as an additional young bull now in the zoological garden at Warsaw

Announcements

SIR LANCELOT GRAHAM, Secretary to the Government of India Legislative Department since 1924, Mr F W Ogilvie, president and vice-chancellor of the Queen's University of Belfast, and Prof G G Turner, professor of surgery in the University of London and director of the Surgical Unit at the British Postgraduate Medical School, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

SIR GEORGE NEWMAN, who has been the chief medical officer of the Board of Education since 1907, and of the Ministry of Health since 1919, will retire on March 31 Dr. Arthur Salusbury MacNalty, a senior medical officer of the Ministry and Deputy to the Chief Medical Officer, has been appointed to succeed Sir George, and Mr Thomas Carnwath has been appointed deputy to the chief medical officer in succession to Dr MacNalty

AT the annual general meeting of the Geological Society of London held on February 15 the following officers were elected *President*, Mr J F Norman Green, *Vice Presidents*, Prof P G H. Boswell, Prof. W S Boulton, Prof H L Hawkins, Sir Thomas Holland, *Secretaries*, Prof W T Gordon, Dr. Leonard Hawkes, *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr F N. Ashcroft, *New Members of Council*, Mr A J Bull, Dr. R G S Hudson, Prof H H Read, Prof H H Swinnerton, Prof W W Watts

MR A. COULSTON EVANS, assistant plant pathologist at the Long Ashton Research Station, University of Bristol, has been appointed assistant entomologist at the Rothamsted Experimental Station Mr. Evans received his training at the Royal College of Science under Profs Balfour-Browne and J. W Munro; also at University College, London, under Prof. J C. Drummond, and the London School of Hygiene and Tropical Medicine under Prof. P A. Buxton. For about eighteen months, he was in France studying sheep blow-fly under Dr F G Holdaway, Council for Scientific and Industrial Research, Commonwealth of Australia, and since August 1934 has been studying fruit pests at the Long Ashton Research Station.

THE portrait of Lord Rutherford, which is Lord Bledisloe's parting gift to New Zealand, was formally presented to the trustees of the New Zealand National Art Gallery at a reception in Wellington on March 1. The Prime Minister of the Dominion as chairman accepted the gift, and in his address paid eloquent tribute to Lord Rutherford In referring to this portrait in NATURE of March 2 (p 334), it was stated that Mr Oswald Birley's original painting is in the Royal Institution This is not correct, the portrait hangs in the meeting room of the Royal Society

WRITING with reference to the article in NATURE of February 23 on "Solid Carbon Dioxide" the general manager of the Carbon Dioxide Company, Ltd, Union Marine Buildings, 11 Dale Street, Liverpool, 2, states that this firm also manufactures solid carbon dioxide, and was, indeed, the first to produce it in Great Britain on a commercial basis. The firm's trade name is 'Cardice'

THE Technical Press, Ltd, of 5 Ave Maria Lane, London, E C 4, has issued a useful classified catalogue of the technical, scientific and industrial books which it publishes The titles of technical books on practically all branches of engineering are given The firm also publishes books on trades and manufactures, arts and handicrafts, and agriculture

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A temporary assistant entomologist in the Advisory Department (Sugar Beet Pests) of the Department of Agriculture, University of Cambridge—The Secretary (March 13) A lecturer in pathology in the University of Liverpool—The George Holt Professor of Pathology (March 15) An assistant botanist in the Ceylon Rubber Research Scheme—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S W.7 (March 16) Two women lecturers in geography and in mathematics at Norwich Training College—The Principal (March 16) A principal of the Municipal College of Technology, Belfast—The Director of Education, Education Office, Victoria Street, Belfast (March 20) Two junior scientific officers at the Torry Research Station, Aberdeen—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (March 22) Assistant laboratory worker in the Plant Pathology Departments of the Royal Horticultural Society's Laboratories at Wisley—The Director, Royal Horticultural Society, Wisley, Ripley, Surrey (March 23) A junior research officer at the Veterinary Laboratory, New Haw, Weybridge, Surrey—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S W.1 (March 25). A scientific assistant in the Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge—The Deputy Director (March 31). An assistant mycologist in the Midland Agricultural College, Sutton Bonnington, Loughborough—The Acting Principal. A senior assistant engineer in the Research Department of Electric and Musical Industries, Ltd—The Employment Department.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 398.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Remains from Kanam and Kanjera, Kenya Colony

THANKS to facilities afforded by the Royal Society and to the courtesy of Dr. L. S. B. Leakey, I have recently had an opportunity of spending about six weeks with the East African Archæological Expedition in the Kendu district of Kenya. The chief object of my visit was to study the geology of the deposits from which the Kanam mandible and the Kanjera No. 3 skull fragments were obtained, for Dr. Leakey had come to the important conclusion that these remains of *Homo sapiens* type occurred *in situ* in beds of Lower Pleistocene and Middle Pleistocene age, respectively. Unfortunately, it has not proved possible to find the exact site of either discovery, since the earlier expedition (of 1931–32) neither marked the localities on the ground nor recorded the sites on a map. Moreover, the photograph of the site where the mandible was found, exhibited with the jaw fragment at the Royal College of Surgeons, was, through some error, that of a different locality; and the deposits (said to be clays) are in fact of entirely different rocks (volcanic agglomerate). Further confusion seems to have arisen over the photograph labelled as the horizon from which the Kanjera No. 3 skull fragments were obtained, this proving to be a cliff of volcanic ash situated some distance away. As the 1931–32 expedition spent three months in the area after the discovery of the mandible at Kanam (its activities being described in Dr. Leakey's field-reports circulated at the time), it is regrettable that the records are not more precise.

The excavations made by the 1934–35 expedition at sites which, one hoped, were close to those of the original finds, revealed the fact that the clayey beds found there had frequently suffered much disturbance by slumping. The date of entombment of human remains found in such beds would be inherently doubtful, and careful investigation of the deposits by an experienced geologist at the time of discovery would therefore be essential. Thus, in view of the uncertain location of the Kanam and Kanjera sites, and in view also of the doubt as to the stratigraphical horizons from which the remains were obtained and the possibility of disturbance of the beds, I hold the opinion that the geological age of the mandible and skull fragments is uncertain.

It will be recalled that on March 18–19, 1933, the Royal Anthropological Institute convened a conference at Cambridge to discuss the evidence of these early human remains[1]. It would appear, from the circumstances just mentioned, that the evidence placed before the conference was unintentionally misleading. The Geological Committee at the conference prefaced its conclusion as to the stratigraphical age of the remains with the phrases "From the evidence supplied by Dr. Leakey, the Committee can see no escape from the conclusion. . . ." It seems likely that if the facts now brought forward had been available to the Committee, a different report would have been submitted.

There still remains for consideration the state of mineralisation of the bones, and the succession of implements from the Kendu area. The degree of mineralisation is undoubtedly high, but such a feature can be used only comparatively and with due caution[2]. I am satisfied, however, that the human remains in question are much more highly mineralised than are those excavated from shell mounds in the district, believed to be Mesolithic, which are the only other human bones we have for comparison. The implements actually found in undisturbed deposits in the district are not numerous; they include a few pebble tools from the Kanam area, and a few Chellian tools from the Kanjera area four miles away. These occurrences appear to me to be far too meagre to constitute a succession of types similar to that at Oldoway, in Tanganyika[3].

It is disappointing, after the failure to establish any considerable geological age for Oldoway man (of *Homo sapiens* type)[4] that uncertain conditions of discovery should also force me to place Kanam and Kanjera man in a 'suspense account'.

Finally, it is a pleasure to record that, during the last week of my work in the Kendu area, I had the benefit of the wide experience and sound judgment of Mr. E. J. Wayland, director of the Geological Survey of Uganda. Without committing Mr. Wayland in matters of detail, I am able to say that he agrees with the main conclusions I have expressed above.

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and Technology,
London, S.W.7.
Feb. 21.

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[1] NATURE, 131, 477; 1933.

[2] See, for example, Andrews, C. W., *Geol. Mag.*, p. 110, 1912.

[3] *Ibid.*, Cambridge Conference, Archæological Committee's Report. "At Kanam and Kanjera, stratified deposits include a similar series of industries . . . ." (that is, similar to Oldoway).

[4] *ibid.*, 131, 397; 1933.

Cosmic Rays and Novæ

PROF. W. KOLHÖRSTER[1] has recently described some fluctuations in the observed intensity of cosmic rays in December last, which he suggests may possibly be connected with the appearing of Nova Herculis at that time. Without venturing to judge of the reality of this particular correlation, one may inquire whether it is in general possible that nova outbursts could supply energy sufficient to maintain the supply of cosmic radiation, or a large fraction of it.

Let us suppose there is an average total liberation of cosmic ray energy E in a single nova outburst. The number of such outbursts in the galactic system is not known, but it has been estimated (Bailey) that there are one or two novæ per year of apparent magnitude at maximum less than 6 The mean absolute magnitude at maximum appears to be about − 5, which gives apparent magnitude 6 at 5,166 light years distance. Hence we should certainly not underestimate E if we suppose there is one nova per year at distance $r = 5{,}000$ light years, and that this one is solely responsible for the cosmic rays in our neighbourhood This would give an average energy flux $F = E/4\pi r^2 Y$ per cm ^{2} per sec outside the earth's atmosphere, where $Y = 3·156 \times 10^7$ sec = 1 year This does not imply that a nova outburst lasts on the average just one year, it gives merely an estimate of the rate of supply of cosmic ray energy if one nova appears per year at distance r Further, Regener[2] has estimated the flux of cosmic ray energy outside the atmosphere to be $3·53 \times 10^{-3}$ erg/cm ^{2}/sec Setting F equal to this value, we find $E \sim 3 \times 10^{49}$ ergs This should be an upper bound, and it should be safe to conclude that if a single nova is capable of liberating energy of this order, then, so far as energy considerations go, such processes could maintain the observed intensity of cosmic rays

Now Milne[3] takes a typical nova outburst to be one in which a star of initial effective temperature $T_0 \sim 8{,}000°$ collapses to a state of final effective temperature $T \sim 40{,}000°$ Also he takes the total luminosity as about the same before and after collapse, so that $R_0 T_0^2 = RT^2$, where R_0, R are the initial and final radii If then we take a star having initially solar dimensions, its initial negative gravitational energy is on Eddington's model $5·66 \times 10^{48}$ ergs This quantity is inversely proportional to the radius, so that if the radius changes in the ratio $(R_0/R) = (T/T_0)^2 = 25$, then its final value is $1·42 \times 10^{50}$ ergs. Hence the total gravitational energy liberated in the collapse is $\sim 10^{50}$ ergs This estimate was first given by Milne[4], and is independent of any theory of what happens during the actual outburst Nevertheless, he does not consider that such a large energy liberation can in fact take place, for on his stellar models the mass is much more concentrated towards the centre than in Eddington's, so the potential energy change corresponding to a given radius change is smaller Hence it appears that if stars are built on Eddington's model, then it may be possible that nova outbursts are adequate to supply the energy of cosmic rays Whether the gravitational energy is liberated in the form of cosmic rays or not, is of course another question If, however, the stars have much higher central densities, then apparently the energy supply from this source would not suffice

A more definite verdict can at present scarcely be given One needs to know more about the structure of a star just before and just after the nova phase, and more about the distribution of novæ in space In regard to the latter, it may however be pointed out that Kolhörster tentatively connects a 2 per cent increase in cosmic ray intensity with Nova Herculis Since estimates of the total number of novæ in the galaxy give 20–30 per year, he considers this fraction not unreasonable if novæ have the importance suggested However, almost all these novæ are much fainter than Nova Herculis, which should therefore make a much *larger* percentage difference.

Finally, it need scarcely be said that if the origin of cosmic rays is to be traced to novæ, then their liberation of energy in this form must vastly surpass that in the form of light For Regener's estimate gives a cosmic ray intensity almost equal to the total intensity of starlight The latter is equivalent to the light from about 2,000 first magnitude stars, while a nova rarely reaches first magnitude, and so makes but little difference to the total light intensity Actually, Unsöld has evaluated the total light emitted in a typical nova outburst as 6×10^{44} ergs, a quantity small compared with the order of 10^{49} ergs seen to be necessary for cosmic rays

W H McCREA

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Feb 7.

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[1] *Z Phys*, **93**, 429, 1935
[2] *ibid*, **80**, 666, 1933
[3] *Observatory* **54**, 126, 1931
[4] *ibid*, p 144

Ratio of the Magnetic Moment of the Proton to the Magnetic Moment of the Deuteron

IN a previous paper[1] it was shown that it is possible to estimate the ratio of the magnetic moment of the proton to the magnetic moment of the deuteron (μ_H/μ_D) by comparing the rates of the reactions

$$\text{ortho H}_2 + O_2 \rightleftarrows \text{para-H}_2 + O_2 \qquad (1)$$
$$\text{ortho-D}_2 + O_2 \rightleftarrows \text{para-D}_2 + O_2 \qquad (2)$$

The ortho para transitions occur in the reactions (1) and (2) under the influence of the inhomogeneous magnetic field during the collisions with oxygen molecules[2]

Since the theory of the paramagnetic ortho-para-hydrogen conversion[3] has recently been investigated in some detail[4], and in addition more heavy hydrogen has become available, the ratio μ_H/μ_D has been re-determined The results obtained are given below

Temperature T (° K)	$k_{H_2}^{(2T)} / k_{D_2}^{(T)}$	μ_H/μ_D
83	12·5	3·85
193	14·5	4·03
293	14·8	4·07

$k_{H_2}^{(2T)}$ and $k_{D_2}^{(T)}$ denote the velocity constants for the reaction (1) at the temperature $2T$ and that for the reaction (2) at the temperature T respectively The ratio μ_H/μ_D is calculated according to the formula given by Kalckar and Teller[4]

$$(\mu_H/\mu_D)^2 = a\, k_{H_2}^{(2T)} / k_{D_2}^{(T)}$$

where $a = 9/8 = 1·12$ for $T > 120°$ K and $a = 1·18$ for $T = 83°$ K The variation of the ratio μ_H/μ_D with temperature is within the limits of experimental error, which is less than 5 per cent.

The present ratio is in agreement with the values for μ_H and μ_D obtained by the magnetic deflection method[5, 6] It should be mentioned, however, that the ratio μ_H/μ_D as determined by the deflection method is not very certain owing to the great limit of error in the measurement of the absolute values for μ_H and μ_D

L FARKAS
A. FARKAS

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Feb 14.

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[1] Farkas, Farkas and Harteck, *Proc Roy Soc*, A, **144**, 481, 1934
[2] Farkas and Sachsse, *Z phys Chemie*, B, **23**, 1, 19; 1933
[3] Wigner, *Z phys Chemie*, B, **23**, 28, 1933.
[4] Kalckar and Teller, NATURE, **134**, 180. 1934
[5] Estermann and Stern, NATURE, **133**, 911, 1934 *Phys Rev*, **45**, 761, 1934
[6] Rabi, Kellogg and Zacharias, *Phys. Rev*, **45**, 769, **46**, 157, 163, 1934

(*Continued on p* 393)

Supplement to NATURE

No 3410 MARCH 9, 1935

Reviews

An Encyclopædia of Natural Science

Handworterbuch der Naturwissenschaften Zweite Auflage Herausgegeben von R Dittler, G Joos, E Korschelt, G Linck, F Oltmanns, K Schaum Band 1 · *Abbau—Blut* Pp x+1078 56 gold marks Band 2 *Blutenpflanzen—Dutrochet* Pp viii+1172 61 gold marks Band 3 · *Echinoderida—Fette.* Pp vii+1230 67 gold marks Band 4 *Fische—Geuther* Pp viii+1270 67 gold marks Band 5 · *Gewebe—Kutzing* Pp viii+1286 67 gold marks Band 6 *Lacaze-Duthiers—Morison, Robert* Pp viii+1134 61 gold marks Band 7 *Morphologie der Pflanzen—Poisson* Pp viii+1140. 61 gold marks Band 8 *Polarlicht—Siemens.* Pp. viii+1248 67 gold marks Band 9: *Silikate—Transformatoren.* Pp viii+1158. 61 gold marks Band 10 · *Transplantation bei Tieren—Zwillinge und Zwillingsforschung.* Pp. viii+1090. Dazu *Sachregister und Systematische Inhaltsubersicht* Pp 242+16 73 gold marks (Jena Gustav Fischer, 1931–1935)

THE attempt to compress into an encyclopædia of ten volumes our present knowledge of the main facts and theories of the natural sciences is an undertaking ambitious enough to daunt even the most courageous of authors and publishers. The volumes here before us, however, cannot but be received with unstinted praise They owe their origin to the enterprise of the founder and original proprietor of the publishing house of Gustav Fischer, Jena, who felt that increasing specialisation in the sciences during the last decades had made it difficult for all except those directly connected with university institutions to keep in touch with subjects not involved in their ordinary activities. Moreover, there was the danger that science was tending to be regarded as a heterogeneous sum of unconnected spheres of knowledge and not as a harmonious whole, the *gestaltetes Wissen* which is so aptly expressed in the German word *Wissenschaft.* Our interest in the individual leaf must not extinguish our desire to see the whole tree.

Some four hundred scientific workers were therefore invited to collaborate in producing an authoritative and comprehensive work which, it was hoped, would be worthy to become the standard work of reference for the natural sciences This hope has been fully realised The second edition which lies before us is remarkably up-to-date in the information it gives Three of the original editors (H Th Simon, M Verworn, E Teichmann) have died since the appearance of the first edition, and the present editors are R Dittler (Physiology), G Joos (Physics), E Korschelt (Zoology), G Linck (Mineralogy and Zoology), F Oltmanns (Botany) and K. Schaum (Chemistry) At the beginning of each volume there is a list of contents, giving the heading and the author of each article in alphabetical order as in the actual text This preliminary index is particularly convenient for quick reference and also for finding out under what headings subjects are to be found

Chemical elements are treated in groups in accordance with the periodic classification For example, we find under the heading *Berylliumgruppe* a detailed account, covering 58 pages, of the discovery, occurrence, preparation, application, electrochemistry, analytical chemistry, thermochemistry, photo-chemistry and colloid chemistry of the elements beryllium, magnesium, calcium, strontium, barium, radium, zinc, cadmium, mercury and their compounds Many interesting observations are contained in this article; for example, that beryllium is seventeen times more transparent to X-rays than aluminium and has therefore been recommended for windows in X-ray apparatus, and that in 1927 one gram of beryllium metal cost 200 marks whereas in 1930 one kilogram cost less than 1,000 marks. It is significant that, of the four references given for beryllium, one is to the scientific publications of the *Siemens-konzern,* by whom a special issue dealing only with beryllium was issued in 1929, and one is to a publication of the Canadian Department of Mines It is doubtful whether sufficient attention has been directed in Great Britain to the great industrial possibilities of this very light metal

If we wish to refer to the atom we find four headings: *Atombau* (Estermann), *Atomkernstruktur*

(Kirsch), *Atomlehre* (Drucker), *Atom- und Molekular-strahlen* (Estermann) These articles occupy nearly fifty pages and, although highly condensed, contain everything of importance and much that will be new to many readers. In a set of volumes of such wide scope it is impossible to attain uniform excellence of treatment, and although the standard throughout is maintained at a high level, a certain unevenness is manifested in the number and quality of the bibliographical references In some cases references to German sources only are given, in others the most important non-German books are extensively quoted It would be a great help to the English and American reader if a little more space could be given in the next edition to the outstanding English treatises in some of the subjects A good example is set in the splendid article on the theory of elasticity (Th v Kármán) which refers to three French, four English and six German works

The subjects concerned with the different aspects of electricity occupy 383 pages in the third volume alone, there are additional articles in other volumes (for example, transformers) Concerning properties of matter there is an attractive article on surface tension (*Oberflachenspannung*) by Auerbach, copiously illustrated by diagrams taken largely from vol 7 of the "Handbuch der Mechanik". The theories of Lipmann, Helmholtz, Nernst and Krüger are briefly but lucidly described and there is also a note on electro-capillarity, the capillary telephone of Bréguet and Livén and the electro-capillary motor of Lipmann Attention may also be directed to the following among many excellent articles radiometer effects (Gerlach), northern lights (Angenheister), science of aviation (Everling), statistical physics (von Laue), stellar spectra (Siedentopf), scattering of light (Pringsheim), all of which are well illustrated.

Of the biological contributions, it may be said that, on the whole, the longer articles appear to attain a higher standard than the shorter ones More than 150 pages are devoted to the propagation of plants, no less than ten writers having contributed to the various sections We note with pleasure that Prof. F. O. Bower (Ripon, formerly of the University of Glasgow) is the author of two of these, dealing with Archegionata. Lundegårdh (Stockholm) has written the article on cyclic changes of substances in the organic world; the lengthy and elaborate article on the geography of plants is by Firbas (Göttingen) and Rikli, Rübel and Schröter, all of Zurich. An article on the nerve system seems rather old compared with most of the other contributions, very few references are to works later than 1911 and that to Sherrington bears the date 1906. The same criticism applies in a lesser degree to the article on breathing, in which J S Haldane's work is inadequately represented. These two articles might well be re-written or at any rate extended when there is a call for another edition In contrast with these, the article on the sense of touch has been excellently written and illustrated by von Skramlik (Jena). Biochemists will find a rare feast in the article on fermentation, among the contributors of which are Neuberg, Luers and Windisch Nor must we omit to mention the masterly survey given under the heading "System and Nomenclature of Chemical Substances"

Biographical notes on the life and work of eminent scientific workers of the past are also contained in these volumes, most of them have been written by Emilie Drude of Gottingen Living scientists are, rightly, not included These notes give the main essentials as regards dates and important discoveries, and also arresting details of the personal life of the savant in question We learn, for example, that Joseph von Fraunhofer, born in 1787 near Munich, was the son of a master glazier and had not yet learned to read or write when at the age of twelve he became an orphan King Max of Baden happened to have his attention directed to the boy and gave him money to buy books The youth, although entirely self-taught, became in 1818 the director of an important optical firm in Benediktbeuren, which later established itself in Munich In 1823 he was elected to the Academy of Sciences and appointed professor of physics at Munich, and a year later he was knighted His discovery of the dark lines in the solar spectrum was made in 1814; three years of further work led him to the construction of the first diffraction grating He died in 1826.

The short sketch of Johannes Kepler's life is also characterised by some personal touches. On one occasion, just after he had discovered his Third Law, he had to interrupt his work at Linz and hasten home to the help of his mother, who was in danger of being burnt as a witch. He was never free from financial worries, for his patron, Kaiser Rudolf II, rarely paid him his salary in full, and his attempts to enlist the help of Wallenstein were unsuccessful When at last he went to Ratisbon to apply to the Reichstag for the balance of his salary, he was attacked by fever and died.

The biographical notes thus reflect interesting sidelights on the private lives of the earlier men of science, and have been written with commendable taste and discrimination

The supplementary index volume (*Sachregister*) contains not only an alphabetical list of the technical references, in which the proper names and the headings of the articles are made prominent by being printed in heavy type, but also a systematic table of the articles (with the names of their authors) under their respective headings For example, the articles dealing with botany are collected together and subdivided into nine sections, each of which contains a list of all the articles concerned with the subject-matter of that section This index and classified list considerably enhance the usefulness of the "Handworterbuch"

The volumes have been handsomely produced in the manner of Abderhalden's "Handbucher" and the numerous diagrams (more than 9,000 in the ten volumes) have been excellently drawn We are, indeed, accustomed to sets of volumes of this kind coming from Germany, a country where it appears comparatively easy to persuade scientific workers, no matter how fully occupied in routine work, to write their contributions without delay, and to find publishers who can get the volumes out in relatively few months Until the speed of working is accelerated in other countries, we are unlikely to find similar sets of handbooks on science produced in other languages

As it is desirable and in many cases even essential that these series of "Handbucher" (Physik, Experimentalphysik, Kosmische Physik, Technische Physik—to mention only the volumes on physics) should be intelligible to science students generally, the question naturally arises whether the amount of German taught in English schools meets the requirements of those who will later be engaged in scientific pursuits, whether academic or industrial No research worker can nowadays afford to be without at least a sound reading knowledge of German , and many teachers, too, would find it a boon to be able to keep in touch with the progress and methods of education in a country which has played such a pioneer part Is it too much to hope that German will soon be introduced into our schools as a compulsory subject for the great number of boys whose ultimate goal is a scientific profession ? It is true that the many translations from the German which have appeared in recent years have been a valuable aid to study in various fields, but translations rarely appear until a considerable time has elapsed after the publication of the original work, and their usefulness and freshness is therefore much reduced Moreover, in the case of research papers complete translations are, of course, out of the question

In other ways, too, the increased study of German would have its advantages in bringing the youth of England into closer contact with a great country, for which many of us have a deep and lasting affection and from which no man of science can fail to draw inspiration.

HENRY L BROSE

The Analysis of Mind

Manual Skill its Organization and Development By Dr J W Cox (Cambridge Psychological Library) Pp xx + 247 + 1 plate (Cambridge At the University Press, 1934) 16s net

IN 1904 Prof C Spearman began that long series of papers, culminating in 1927 in his book "The Abilities of Man", which gave to psychology a new method of attack upon the problem of mental constitution This method combined two techniques which were then coming into use in psychology, those of correlation and of mental testing It made possible the analysis of a concrete function such as addition It was possible to determine not only how many factors were involved but also which of them were general, that is, common to all abilities, which were group factors, that is, common to some but not all abilities, and which specific to the ability in question It was even possible to estimate the relative importance in that ability of the various factors

It was clear that only very extensive investigation could realise the full value of the Spearman method Dr J W Cox is one of those who are bringing this realisation nearer In 1928 he published what is still perhaps the best account of the investigation of a group factor ("Mechanical Aptitude" Methuen, 1928) He showed that efficiency in a 'mechanical' function, for example, the solution of an engineering problem, depends partly upon a general factor—the Spearman *g* or general intelligence, partly upon a factor specific to that function, and partly upon a group factor co-extensive with the field of 'mechanical' or engineering functions—the mechanical factor *m* From the point of view of vocational selection and guidance, the demonstration of this mechanical group factor was especially important

The present work is both a continuation of the earlier work and a breaking of fresh ground. It applies the same method to manipulative functions, chiefly to the assembling and stripping of an electrical lampholder Assembly was split into five operations which constituted five 'assembling tests'. These were used in two ways When first applied, the mode of assembly being still a problem, they were 'mechanical assembling tests' After familiarisation, they were 'routine assembling tests' The four 'stripping tests' were used only as 'routine tests'

These tests, along with tests of intelligence and of mechanical ability, were applied to groups of school children Analysis showed that the mechanical assembling tests involved the general factor *g*, the group factor *m* and specific factors, whilst the routine assembling tests involved not only g, m and specific factors, but also a group factor especially associated with routine manual work. The application of other manipulative tests showed that the manual factor was of wider scope than lampholder operations. It is to be noted, however, that both m and g tend to be negligible in simple manual functions, and m in the stripping tests as well. Furthermore, whilst the manual factor is common to routine and manual assembling and to simple manual operations, it tends to disappear in favour of specific factors in operations calling for speed rather than the careful adjustment of parts, such as stripping. It is clear that if the manual factor is to be measured precisely in individuals, operations of the assembling rather than the stripping type, and complex rather than simple, are called for. But precise individual measurement of the manual factor is further in the future than of the mechanical factor.

The demonstration of a new group factor is enough in itself to make Dr Cox's book important. It contains, however, many other important findings. Of these it is possible to mention only that relating to the transfer effects of practice and training.

Woodrow showed in 1927 that training, that is, instruction in suitable methods of memorisation together with practice in memorising one kind of material, improves efficiency in memorising certain other kinds of material, although practice without instruction lacks this beneficial effect. Dr. Cox has found not only that this is true of motor functions but also that the improvability of the functions showing transfer is increased. It is to be noted, however, that the spread of the transfer thus far demonstrated is far narrower than the general transfer claimed by the old 'faculty' psychologists and some modern educationists.

Research among Primitive Peoples

Essays presented to C. G. Seligman. Edited by E. E. Evans-Pritchard, Raymond Firth, Bronislaw Malinowski and Isaac Schapera. Pp. ix + 385 + 19 plates. (London: Kegan Paul and Co., Ltd., 1934.) 21*s*. net.

IT will, no doubt, be the pleasing duty of some future historian of the progress of science in the first third of the twentieth century to trace in the development of anthropological studies the influence of the Cambridge Expedition which set out for the Torres Straits in 1898 under the leadership of Dr. A. C. Haddon. It was as a result of what he saw on that expedition that the late W. H. R. Rivers took up the serious pursuit of ethnology, while on the same expedition Prof. C. G. Seligman, to whom this volume of essays is presented by his friends and former pupils, was inspired with that enthusiasm for research in the field among primitive peoples, which has been the dominating influence in his life-work. How much of this was due to the leader of the expedition, who contributes the foreword to this volume, it is unnecessary to inquire; but the influence, whatever its source, was decisive.

Prof. Seligman, as the earlier entries in the bibliography published here will show, clearly had before him a choice of distinction in more than one branch of scientific research; and his selection of anthropology as his main interest and subject of study has never been allowed to restrict unduly the play of his versatility. This has given his work a flexibility and freshness of outlook, which is exemplified in his published work by his readiness to consider the bearing of advances in cognate subjects of inquiry on the methods of his own branch of investigation. Thus in the wide range of topics covered by the thirty-nine contributors to this presentation volume, some perhaps almost on the fringe, rather than actually within the bounds of the science, there is none to which Prof. Seligman himself has not made some more or less substantial contribution.

In turn he has inspired or interested others. It is in no sense invidious to suggest that much is due to his influence in, let us say, selecting almost at random, the essays by Prof. E. E. Evans-Pritchard on "Zande Therapeutics", the Princess Marie Bonaparte on "Psycho-Analysis and Ethnography", with its stress on the importance of the investigation of primitive peoples before it is too late, Dr. Raymond Firth on "The Meaning of Dreams in Tikopia", or the "Anthropological Approach to Ethnogenics" by Capt. Pitt-Rivers emphasising the practical aspects of anthropology, of which Prof. Seligman has always been an ardent champion. To his example too, no doubt, must be attributed Prof. Malinowski's divagation to an antiquarian topic, upon which he forbears to enlarge, in a description of stone implements from eastern New Guinea.

Where so much is of interest, it is difficult to select any special papers for mention. The reader's preference, whether for material culture, psychology, magic, law or religion, will scarcely fail to find satisfaction somewhere in this long list of contributions. Mr. J. Layard, for example, studies beliefs relating to the journey of the dead in the New Hebrides; Dr. G. Róheim, psycho-analytic methods in the study of character development and the ontogenetic theory of culture; Mr. Henry Balfour describes the peculiar Tandu-industry of Northern Nigeria, by which an animal membrane is made into boxes and flasks; and Prof. J. L. Myres puts forward a theory of the creation of the Tribunes of the Roman Plebs, while Dr R R Marett re-examines the old problem of food rites and their relation to totemism, sacrament and sacrifice

Even where so much is excellent or attractive, one paper stands out, not only on its intrinsic merits, but also for its critical attitude towards traditional anthropological method. This is by Dr A Hrdlička on "The Anthropological Value of the Skull" He traces the history of this character as an element in the study of man and in racial classification, and shows how it came by degrees to overshadow all other characters in the methods of physical anthropology While he does not deny that it has a real value in anthropological research, he maintains that it must be put in proper perspective and its study carried on critically Dr Hrdlička considers that the human body, including the skull, is still plastic and that great changes are going on now, for example, in the Eskimo and the American Indian The latter, indeed, has often so changed under altered conditions as to be almost worthless for type study Coming from so great, and on the whole conservative, an authority, this opinion should give pause to the too ready formulation and acceptance of racial theories

Of this volume as a whole it remains to be said that in form and contents it is worthy of its recipient, and than this there could perhaps be no higher praise The editors have earned thanks and congratulations

A Modern Naturalist

Confessions of a Scientist By Dr Raymond L Ditmars Pp xiii + 241 + 23 plates (New York: The Macmillan Co, 1934) 15s net

DR DITMARS has charge of the reptiles in the New York Zoo, but, as he tells us, he is a kind of chaperone for all its beasts, with a special liking for the more primitive and delicate forms. We tend to think we can buy everything in the way of beasts, living and dead, whereas New York seems to do much of its own collecting This means a personal knowledge on the part of its officers of the beasts in Nature, and, practically in gardens and scientifically in laboratories and museums, this is invaluable.

The assets of a keeper are observation, humour and pluck, and all these the author has to a marked degree His writings are charming and fresh, deservedly meriting their wide clientèle For pluck, read how he made a motion picture of a mamba, the quickest and most deadly of all snakes. The studio was decorated with a young hornbeam, on the spreading branches of which the mamba was induced to lie under the necessary vapour lights Here was the stimulating spring sunshine, rich in ultra-violet, that wakes the mamba—and it is surprising that the author lived to tell his tale, as the reader may see All this work and danger to secure a film ! What folly ? But a film may reveal movements and a play of features, unseen by the eye, and these tell us of the psychology which is as much part of a beast as his anatomy Evidently, the belief is that the film is to become part of the technique of the lecturer in zoology and to this we agree, expecting that in twenty years' time lecture rooms without cinema will be anomalies In Great Britain, the films as yet do not exist, but we look to the Zoological Society of London to give us them It is a society possessed of vision, and it has means It will soon want fresh fields to conquer, and here is one well worthy of its enterprise

To return to our text, the "Episode of the Twenty-Four Tarantulas" must be read The vampire next ! She found her quarters in the Zoo, learning to feed on defibrinated blood which was diluted somewhat for her babes It required time to break her in, but films finally were secured when she approached her dish and fed Her thumb served as a foot and "there was no semblance of a bat, but a weird stalking thing, of the softest gait Bending over the dish, she darted her tongue into the sanguineous meal . . 4 darts a second Her wings spread like a flash and she hooked a hind claw overhead and was hanging, head down Gorged and inverted" More knowledge here than acquired in three hundred years of study Who would have guessed that the vampire alone among bats has the double habits of running and flight ? Is there not something wrong with the scientific worker ? Indeed, how many know that the range of temperature for snakes is only 32°–115° F, and that the parental care of the marmoset father for his children is to secure food for them, despite an always greedy mother

Of course, the author cannot leave the Loch Ness monster alone Who can ! It was one of the biggest items in the world's news in 1933–34 and it lasted longest It is not a reptile, since there is not a reptile living that could exist in the chilly waters of the Loch—and hence it must be a warm-blooded beast, namely, a mammal Like the salmon we caught last month, it doubtless has continued to grow, and hence it might well have been a seal, which, swimming in the surface waters, produces a long wake.

Lastly, we may refer to the use of cobra venom, which has nerve toxins, for the amelioration of malignant growths. It all started with the observation that a marked improvement was shown by a leper after being accidentally bitten by a tarantula Then Dr Ditmars came in as a purveyor of poison, and the results are to be seen in the published accounts of the work of Dr Monae-Lesser showing that the use of cobra venom on cases of tumour, benign or malignant, always relieves pain, often stabilises the growth for a period and even in cases obtains regressions Most snake venom, however, is of a different type, attacking the blood and destroying the red corpuscles and breaking down the walls of the blood vessels Here injections were also tried and were found to produce a surprising effect, they inhibited the bleeding and are thus potentially of considerable use in medicine We wonder what will come next! The last discovery was made on injecting the venom into a rabbit to make its skin more sensitive to the bleeding reaction, while the effects proved exactly the reverse

Cytology and Genetics

Introduction to Cytology By Lester W Sharp (McGraw-Hill Publications in the Agricultural and Botanical Sciences) Third edition Pp xiv + 567 (New York and London McGraw-Hill Book Co, Inc, 1934) 30s net

THE development of cytology in its relation to genetics is a chapter of more than usual interest in the history of biology Cytology in the modern sense developed during the last quarter of the nineteenth century as a purely observational science The general nature and behaviour of cells, nuclei and chromosomes were worked out during that period, although the cell theory, of course, originated much earlier The rediscovery of Mendelism and the announcement of mutation at the turn of the present century marked a new epoch in biology, and soon gave abundant meaning to the observations regarding chromosomes which the cytologists had already accumulated Henceforth cytology and the young science of genetics mutually influenced each other, and each derived increasing strength from the observations of the other

For a time, genetics or breeding experiments were naturally regarded as the dominant member in this remarkable partnership But the early discovery of mutations with different chromosome numbers, of the relation between genetic linkage and the chromosomes, and of polyploidy or chromosome multiples in many plant genera, not to mention the sex chromosome mechanism in animals and its relation to sex-linked inheritance, soon made it clear that cytology would play a fundamental rôle in the future development of genetic research. Nevertheless, many geneticists were slow to realise that the cytologists had provided them with the only mechanism by which their results could be adequately explained The practical breeders, in particular, failed to sense the necessity of calling cytology to their aid in connexion with the improvement of such important world crops as wheat and cotton, until the essential results regarding the chromosomes in these plants had been placed before them by the cytologists This was no doubt partly because cytology requires a special equipment and an exacting technique which some investigators never fully achieve

That geneticists now universally recognise the fundamental importance of cytology for breeding work, even in its most practical aspects, is due to the striking mass of results regarding the chromosomes and their behaviour which cytology has achieved. From being the handmaiden of genetics, cytology has become an equal partner, and to change the metaphor, it has become clear that cytology must continue to provide the foundations on which the superstructure of genetics can be built To judge from the large proportion of genetical papers in which cytological results are reported, it might even be contended that cytology has already reached the dominant position In a recent number of the *Journal of Genetics*, for example, six of the nine papers either reported new cytological results or were based upon cytological facts already known, while in two of the remaining three papers special facts regarding the chromosomes were involved in the interpretation This situation is not surprising, since cytology is recognised as an essential part of the training of the younger generation of geneticists Indeed, the term cytogenetics, now in frequent use, marks the fusion of these two sciences into one, and indicates that cytology will play an essential part in all future development of the subject Genetics without cytology would be like the play without Hamlet

The book before us is a useful introduction to cytology, particularly as regards plants, and much of it is devoted to the cytological foundations on which the structure of modern genetics is reared Its usefulness is attested by the fact that it is the third edition of a work first published in 1921 Large alterations and additions have been made in the present edition, which is much improved thereby, and nearly all the relevant recent work has been included

The work now consists of twenty-six chapters the first seven deal with such topics as the cell, protoplasm, nucleus, plastids, Golgi material, chondriosomes and ergastic substances. The next six chapters are concerned with mitosis, chromosome structure and related subjects, the three following, with sporogenesis, syngamy and meiosis, the phenomena in all groups of plants being compared. The remaining ten chapters, except the last which gives a historical sketch of cytology, are devoted to modern work on chromosomes and heredity, chromosome fragmentation, heteroploidy, cytogenetics of hybrids and related phenomena.

While there are points in which the reviewer would differ from the author in conclusions or treatment, yet it must be recognised that the work is a carefully collated and dispassionately presented account of advances in this wide field. Didactic considerations have not been forgotten, and there is sufficient explanation and comparison with conditions in animal cells to make the book serviceable also to zoologists. Accounts of various phenomena of general interest, such as spermatogenesis and artificial parthenogenesis in animals and endomixis in *Paramecium*, find a place. The extensive references to literature have been mostly relegated to footnotes. The condensed bibliography at the end runs to more than eighty pages, a feature which investigators will find of much value.

The recent developments in the cytogenetics of maize, *Œnothera*, *Datura* and *Crepis* are considered at length, and the chromosome maps of *Drosophila* receive attention. Evidence is presented for the new conception of the nucleolus as a body produced by a particular region of one chromosome pair. The phenomena of synapsis and crossing-over are discussed, the various views being presented without dogmatic adherence to one—a very desirable feature in any work on so intricate a subject. Finally, it may be mentioned that the results of microdissection work and similar studies of the living cell are incorporated.

No doubt the author will be rewarded with the appreciation of cytologists and geneticists for the production of this new and up-to-date edition, which marks the merging of these two sciences in their cognate aspects into one.

R. Ruggles Gates.

Proper Motions of 25,000 Stars

The Radcliffe Catalogue of Proper Motions in the Selected Areas 1 to 115. Compiled by Dr. H. Knox-Shaw and H. G. Scott Barrett. Published by Order of the Radcliffe Trustees. Pp. xlviii + 352. (London: Oxford University Press, 1934.) n.p.

In 1906 Kapteyn published his "Plan of Selected Areas" to bring together the various observational elements necessary for a more complete knowledge of the structure of the system of the stars. To obtain data for the fainter stars (position, proper motion, magnitude, spectrum, radial velocity, and so on), he proposed that samples of 206 areas uniformly distributed over the sky should be completely investigated, and work was apportioned to different observatories. Rambaut undertook the determination of the proper motions over fields of 40′ × 40′, 50′ × 50′, 60′ × 60′, depending on galactic latitude, for the 115 areas from the equator to the north pole. Kapteyn's proposal was that exposures should be made sufficient to obtain stars to a definite magnitude, the plates carefully stored, and re-exposed ten years later with their centres displaced slightly. This method has the disadvantage that at the second exposure, if clouds came up, the necessary limit of magnitude might not be reached. The plan was modified by taking the second exposure on a separate plate, *through the glass*, and measuring the displacements by placing the plates face to face. Rambaut carried on the work from 1907 until 1923, and it has been completed under his successor's direction. The difficulties attending long exposures in the climate of Great Britain are considerable, and although the aggregate exposure time on which the proper motions depend has been only 450 hours, "it has taken 24 years of unremitting effort to achieve this modest score".

The handsome volume published by the Radcliffe Trustees, compiled by Dr. Knox-Shaw and Mr. Barrett, gives the proper motions for 25,000 stars. The average limit of magnitude is 15·2 m., only in ten fields is it below 14·5 m. In addition to the proper motions, magnitudes are determined with a probable error of ±0·108 m. Owing to an adjustment of the telescope in March 1914 by which the tilt of the crown and flint lenses was altered by 1′, the centre of density of the images of the brighter stars was altered relatively to that of the fainter stars, thus introducing a magnitude equation. The effect of this has been successfully eliminated.

The proper motions as printed are relative, as there are insufficient stars of known proper motion to serve as a zero, and it has been considered inadvisable to apply somewhat uncertain corrections for parallactic motion and solar rotation to stars of these faint magnitudes. The probable errors for different areas range from ±0·0025″ to ±0·0060″. By applying the parallactic motion, the apex of the solar motion, and the vertex and axes of the Schwarzschild ellipsoid, have been found for stars 9·0–14·0 m. and those fainter than 14·1 m. It is pointed out that the vertex of Schwarzschild's ellipsoid is the only one of these quantities which can be satisfactorily derived from the relative motions of these faint stars.

The average values of the proper motions for stars at different galactic latitudes are next given and range from 0·010″ on the galactic equator to 0·024″ near the pole for stars of magnitude 9·0 m – 14·0 m, and from 0·010″ to 0·019″ for magnitude 14·1 m – 15·0 m

The stars of proper motion less than 0·1″ are collected and their distribution per square degree given for different galactic latitudes The number of variable stars found is very small, being no more than one star in 2,900.

The Radcliffe Observer and his staff are to be heartily congratulated on the conclusion of this laborious and useful piece of work

F W D

Rapid Physics

Experimental Physics a Selection of Experiments By Dr. G F C Searle Pp xiv+363 (Cambridge: At the University Press, 1934.) 16*s* net

NON cuivis homini contingit adire Corinthum, and those of us who have not been fortunate enough to have come directly under the influence of Searle's inspiring personality, owe him a heavy debt of gratitude for leaving us some record—incomplete though it may be—of the methods which he has practised with such eminent success for nigh fifty years

It is an impressive record, all the more so in that this, his latest, although we hope not his last, volume shows all the vigour and energy and enthusiasm—and thank Heaven, the prejudices—that have ever characterised his work It has been called an "Odds and Ends Book", and never has there been a volume to which the term could be applied with less justification—singleness of purpose and outlook inform and penetrate every page

Skill in design, an uncanny aptitude for hitting on an experiment which will illustrate half a dozen physical principles, a remembrance of the saying that small corrections are the fun of physics, a consequent hunt for the fourth or fifth significant figure even when, Dulong-wise (or is it Petit-wise?), the third may be now and then in doubt; the aptitude of an accomplished craftsman for making the utmost use of simple mathematics; a violent dislike for tobacco—all the characteristics that we know and love are there.

The topics handled—do they really matter? Still, it is usually considered to be the reviewer's first task to give his readers some inkling of the contents of the book, and we have here a record of some thirty-four experiments, four or five being devoted to dynamics, six to elasticity, thirteen to surface tension and viscosity, five to heat, and five to sound. Each of the main sections is prefaced by a chapter dealing with the mathematical principles involved.

There is but one serious criticism to put forward, and that is concerned with a section of the preface which states that the author has "abandoned a former project of writing a manual on *Experimental Electricity and Magnetism*". We trust that the author will, in the comparative leisure that will fall to him after September 30, 1935, reconsider this decision. We have heard old Triton blow his wreathèd horn, and, after revelling in the heartening blasts which he has sounded, we love not the descent to the electrical-and-magnetic bleatings of more orthodox volumes May he be persuaded to wind another strain, this time to the theme of electricity and magnetism! A. F

Reaction Kinetics

The Reaction between Hydrogen and Oxygen By C N Hinshelwood and Dr A T Williamson. Pp v+108 (Oxford Clarendon Press, London. Oxford University Press, 1934.) 8*s* 6*d* net

WITH the rapid development of science, it is very convenient to have in one's hand from time to time a critical and authoritative up-to-date monograph on the present status of some important phases in scientific development Such an account is given by Mr Hinshelwood and Dr Williamson on the reaction between hydrogen and oxygen

The more general implications of the chain mechanism advanced by Nernst to interpret the hydrogen chlorine reaction were pointed out and developed by Semenov, who, in his famous paper of 1927 on the phosphorus – oxygen reaction, not only referred to the hydrogen – oxygen reaction, but also indicated and afterwards investigated with his collaborators the phenomena of homogeneous slow combustion, rapid combustion, degenerate and true explosions, and interpreted the phenomena of upper and lower limits of explosion. The view that such reactions are chain reactions entails an inquiry into the mechanism of the starting, propagation, reflection, branching and cessation of the chains as well as the factors operative in limiting the explosion both at the upper and lower limit These reactions form not only an important connecting link between surface or heterogeneous catalytic actions and true homogeneous reactions, but also provide us with a means for obtaining, admittedly in small concentration, new and reactive chemical entities, the chain carriers.

It is generally admitted that the hypothesis of simple atomic links such as obtain in the reactions investigated by Polanyi is not adequate to interpret the experimental data in chain reactions such as that of hydrogen and oxygen, likewise the concept of the 'hot molecule' or energy rich molecular species such as $H_2\overset{\times}{O}$ is falling more and more into disfavour. Interest is being centred more on unstable radicals which act as links and diffuse through the gas.

It may be observed as first suggested by Melville that an idea as to the nature of the carrier might be obtained from its diffusion coefficient. This is discussed on pp. 60–61 of the present volume; in the equation given, the symbol D does not actually represent the reciprocal of the diffusion coefficient, but is only proportional to it for a given inert gas pressure. Such explosive limits as are found are sometimes governed by an asymmetrical relationship between the products of the reacting gases, but this symmetry can be disturbed very considerably if the collision efficiencies for reaction of the two chain carriers are very different. In this connexion it is interesting to note that there appear to be many points of similarity between the radicals of the type XH, for example, O_2H, CH_2H., $CH_2 CH.H$. At the same time, the old idea that radiation and ionisation play an important part in the wave front of a propagated explosion appears to be entering on a new lease of life.

All those who are interested in the question of reaction kinetics must thank these authors for a well-documented monograph written with the clarity and in the style that we are accustomed to find in the communications from the Oxford laboratory.

E. K. R.

Television Systems

(1) *Television: To-day and To-morrow*. By Sydney A. Moseley and H. J. Barton Chapple. Fourth edition. Pp. xxxi+208+71 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1934.) 7*s*. 6*d*. net.

(2) *Television: Theory and Practice*. By J. H. Reyner. Pp. xi+196+12 plates. (London: Chapman and Hall, Ltd., 1934.) 12*s*. 6*d*. net.

THERE is not yet a really good book in English on television. Schröter's excellent "Handbuch" was an admirable German model to which to work, although it is now happily out-of-date despite its completeness at the date of publication and its comparative youth. Neither of the present works reaches Schröter's level, although Reyner's survey is the best that has yet appeared in English.

(1) Moseley and Chapple have been noticed in earlier editions; they might well have taken the opportunity offered by a fourth edition to lop off much dead wood. The main criticism even of this new edition is that it contains much more television of yesterday than of to-day or to-morrow. Now that the Television Committee has administered the *coup de grâce* to that low-definition television which was an experimental triumph and an entertainment travesty, the authors would do well to condense into a brief single chapter the story of television before 1930, and to expand their treatment of the newer high-definition systems. They might at the same time judiciously excise from Mr. Moseley's preface his curious reference to "the adoption of the cathode ray system after it had been practically flung on the scrap heap". Whoever flung it on the scrap heap was a singularly wrong-headed individual sinning against the light, for there has always been a very strong body of expert opinion pressing towards that cathode ray system which has now, after an unnecessary delay and at a remarkable ultimate speed, been brought to a stage the merits of which are attested by the recommendations of the Television Committee. A decent veil might well be drawn, in preface and book, over this major error of judgment.

The most interesting chapters of the new edition are xiii and xiv, which attempt to compress into some thirty pages the basis of cathode ray systems, the utilisation of ultra-short waves, and the intermediate-film process. If the fifth edition devotes 175 pages to these subjects, and relegates to 25 pages the matter which now occupies these 175, the book will be vastly improved.

(2) Mr. Reyner can view the subject from a greater distance, and the improved perspective of this tele-vision results in a much better book. At an epoch when even weeks are of importance in the history of the subject, it is fair to record that the author's preface is dated March, 1934. For that date the book is remarkably up-to-date, giving a whole chapter to velocity-modulation, and brief but clear accounts of the Zworykin iconoscope and the Farnsworth image dissector, important competitors in the field of true television as opposed to the more highly developed methods which may be unambiguously if inelegantly labelled 'telefilm'.

After good comprehensive surveys in the two opening chapters, the first in general terms, the second detailing the instrumental arrangements, the author passes to physiological optics in Chap. iii, to the optical elements of mechanical television systems in Chap. iv, and thence to a very useful chapter on the technical characteristics of photo-electric cells. In satisfactory contrast to Moseley and Chapple, Reyner then devotes three chapters to the essentials of cathode ray television. These chapters may be specially commended as very fairly representative of the material published up to the middle of 1934. Indeed this commendation may, as has already been suggested, fairly be extended to all the seventeen chapters of the book

We may hope that the author and his publishers may be moved to produce, in the next few months, a new edition including the wealth of material which is now being released as a result of the Television Committee's report Such a work would be assured of a wide circulation in the autumn, meanwhile, the present edition is a very well-balanced and accurate introduction to a subject which has now definitely climbed from mere curiosity value to real entertainment value

Progress and Economics

The Economic Consequences of Progress By Roy Glenday Pp xv+302 (London George Routledge and Sons, Ltd, 1934) 12*s* 6*d* net

THERE must be progress—even in the desert the camel is giving way to the motor-car, it is not an accident but a necessity It has far-reaching economic consequences which have proved to be unequal in their incidence on different peoples and on different strata of society Applied science is affecting the daily life of everyone to an ever-increasing degree Its supposed advantages appear sometimes to conflict with the existing state of affairs, but they are none the less real, and nothing can stop the progress of science or deprive the people of the new benefits which they are to receive by science

Nearly a hundred years ago, we in England were in the "hungry forties"—words then pregnant with real meaning of scarcity, even starvation It is stated that at the beginning of the eighteenth century, approximately one third of the population of these isles was unable to live honestly, while another third was living close to the margin of subsistence To-day there is an over-production of the essential foodstuffs which is directly due to the application of science, thus the yield of grain per acre has been increased five-fold, the average yield of milk from dairy cows is more than doubled and could be doubled again, whilst the egg yield from hens has been doubled during the last twenty-five years The world over, the price of food has fallen in consequence and the farmer is hard put to it to make a living, particularly when he is burdened with a mortgage at a high rate of interest. It is clear, moreover, that the cost of production of many foodstuffs will continue to fall. Further, the invention of cold-storage and quick long-distance transport has made the surplus food supplies of the world available in Great Britain

The standard of living, according to Sir Josiah Stamp, has increased by more than four times during the past century The economists tell us that it was not until man learned how to increase food supplies more rapidly than the rate of growth of the population that he was really able to make progress in wealth

The economic consequences of progress as we find them in 1935 are so diverse, and can be viewed from so many angles, that the business man is inclined to distrust economics as a science, and to believe that his practical experience is nearer the truth than the theories of the academic economist It may be that progress follows a series of cycles of growth and decay or, as we term them, prosperity and depression, but it should not be beyond the wit of man to flatten the curves Before this can be attempted with any possibility of success, it is obviously necessary to have a full understanding of the problems such as the book before us seeks to provide

Mr Glenday's close touch with the business community enables him to write from an angle which the business man understands In the first half of his book he traces the laws of growth and structure which have in fact controlled progress, in the second he deals with the future with a prophecy of what must be done to prevent disaster His final attitude is in effect that we should abandon the economic struggle for increasing wealth and seek happiness and cultural progress by other means, involving a largely planned civilisation and controlled population we must learn to control our numbers and their output of goods

The fundamental changes in this direction which the great combines and the men in charge of them are bringing about are stressed by Mr Glenday It is significant to find him recording that many of them "are tending less and less to regard their undertakings as mere profit-making machines for absentee shareholders and more and more to behave as the leaders of the armies of industrial advance"

The new science of 'scientific management', on which there is to be an International Congress in London this year, deals essentially with the "art of generating, utilising and controlling educational forces within industry and without, so that the human industrial team can continually be equipping itself for performing its task with a degree of efficiency ever on the upgrade". We quote this definition of management from a letter in *The Times* of January 2, 1933, signed by thirty-one leaders of industry, commerce and finance

The author has given us a readable book, erudite and enthusiastic; we commend it warmly to all interested in these problems, which concern each one of us deeply.

E. F. A.

Short Notices

Archæology and Ethnology

The Annual of the British School at Athens No 32 *Session 1931–1932* Pp viii+310+42 plates (London Macmillan and Co, Ltd, 1934) 63s net

THE "Annual of the British School of Archæology at Athens" has established a reputation for a high standard of accuracy and scholarship in the presentation of the work of its members and students from year to year The present volume, which covers the session 1931–32, in this respect in no way falls short of the achievement of its predecessors These qualities indeed are the more noticeable from the fact that at present no operations of the first magnitude by the School fall to be chronicled It must not, therefore, be assumed that the contents of the present volume show any failing in interest This is far from being the case Mr N G L Hammond, for example, in his "Prehistoric Epirus and the Invasion of the Dorians", presents the archæological and historical argument in a manner as skilful as its subject is intriguing Miss Winifred Lamb's account of her excavations at Antissa have carried on a piece of work essential in duration to her previous excavations, and Mr S Benton's report on a tour of the Ionian Islands, combining a certain amount of rapid field-work with material from museum collections and other sources, would be found more than suggestive, if only money and opportunity were available for further research Among the remaining papers, Mr R P Austin reports on his excavations at Haliartos on the site of a sanctuary dating from 550 B C, Mr J D Beazley describes groups of mid-sixth century Black Figure ware and Mr R J N Jenkins some archaic Argive terra-cotta figurines The illustrations, as usual, are liberal and excellently reproduced

The Greatness and Decline of the Celts By the late Henri Hubert Edited and brought up to date by Prof Marcel Mauss, Raymond Lantier and Jean Marx Translated from the French by M R Dobie (The History of Civilization Series) Pp xvi+314 (London Kegan Paul and Co, Ltd, 1934) 16s net

IN this volume, which forms the second instalment of the late M Henri Hubert's study of the Celts, the author is no longer entirely dependent on the indirect evidence of archæology He has had at his disposal the statements of classical historians and geographers, and in the later periods a mass of material of a miscellaneous character and varying degree of authority drawn from traditions, annals and other forms of literary record. Taking the middle of the first millennium B C as his starting point, he traces the expansion of the Celts from their home in Central Europe into Italy, Spain, Gaul, the British Isles and eastward to their point of farthest penetration in the Ægean and Asia Minor. M. Hubert then follows their decline in the struggle with Rome and the Germanic peoples, until in the modern world Ireland alone remains as their sole independent and national representative in a political sense

M Hubert has reconstructed a picture of Celtic society and culture out of the reports of classical historians and geographers and the material afforded by the heroic traditions and other literary remains of the Celts themselves It suffers from the necessary limitation that it applies primarily to the Celts of Gaul and Britain only, and is not chronologically homogeneous, but the author argues with some considerable effect for its general applicability

Creation and Evolution in Primitive Cosmogonies, and other Pieces By Sir James George Frazer Pp xi+151 (London Macmillan and Co, Ltd, 1935) 8s 6d net

SIR JAMES FRAZER has here reprinted a number of 'pieces', of which the title piece of the volume is the most substantial It appeared originally in the Darwin memorial volume, published in 1909 It brings together a number of instances to show that both the concept of a special act of creation and something in the nature of the evolutionary theory are found in primitive cosmogonies Among the subsequent essays are the Zaharoff Lecture on Condorcet delivered in Oxford in 1933, biographical sketches of Sir Baldwin Spencer and the Rev John Roscoe, some reminiscences of the author's early life in Glasgow in a speech of thanks when the freedom of his native city was conferred upon him, and some memories of his parents Each of these pieces, it is scarcely necessary to say, bears the hall mark of the author's charm and finished style

Biology

The Myxomycetes a Descriptive List of the known Species with special reference to those occurring in North America By Thomas H Macbride and G W Martin Pp x+339+21 plates (New York The Macmillan Co, 1934) 25s net

THE slime moulds are found in decaying organic matter in every country of the world, and they are probably inhabitants of all soils So far as is known, they have no economic importance and in consequence of this they are neglected Their formation of hard fructifications, in which the spores lie, gives structure upon which a classification may be based, but their systematy is of peculiar difficulty on account of an obvious responsiveness to environment while their fructifications are forming How many thousands of species of these animals or plants, whichever they be, exist in the world we do not know, but the work before us represents six years labour on the part of Dr Macbride and his research assistants. About 400 species are described in this monograph, but it occurs to us how much more interesting and stimulating it would be, had it been preceded by a full well-illustrated account of the biology of these organisms. The 573 figures, so careful for form but tiny and uncoloured, cannot tell their exquisite story and are of little use to recruit future workers; they will be the better understood if used in connexion with Arthur Lister's coloured plates in his monograph of 1911.

Taxonomy is not an end in itself. Indeed, it is merely a convenient method of cataloguing, and something apart from modern conceptions of science. To the reviewer it is by itself analogous to stamp collecting and cataloguing—quite a good amusement but leading nowhere. It becomes interesting when the stamps are studied in relation to the histories of countries, as these Myxomycetes might well be if described in relation to their environment.

Insect Physiology. By Dr. V. B. Wigglesworth. (Methuen's Monographs on Biological Subjects.) Pp. x + 134. (London: Methuen and Co., Ltd., 1934.) 3*s.* 6*d.* net.

ENTOMOLOGISTS have seldom concerned themselves with problems of insect physiology. The study of structure, habits and taxonomy in so vast a class has monopolised the field. What is known of insect physiology has, for the most part, resulted as a side-line or by-product of other investigations, rather than as the outcome of the study of insects as such. In the last ten years or so, entomologists have come to realise the necessity for exact knowledge of the functions of insect organs and tissues, especially in regard to the problems of insect control. It is in the latter connexion, perhaps more than any other, that our ignorance of physiology has revealed itself most.

In writing this handbook, Dr. Wigglesworth imparts to his subject a freshness of outlook which only comes to a writer who has acquired first-hand knowledge. His own researches into the physiological make-up of insects have broken new ground, and are always suggestive and productive of ideas. The results of these studies find their place in the book but, at the same time, the author has explored the literature on insect physiology with admirable thoroughness (as the bibliography will testify) and subjected it to critical selection. In a sense, the book is quite unique since it has no competitors; the only previous survey of the subject at all comparable is that of Marchal, published in 1911. It needs no further recommendation, and every entomologist and zoologist should possess it. A. D. I.

The Familiar Trees of Hopei. By Hang-Fan Chow. (Fan Memorial Institute of Biology, Peiping, Handbook No. 4.) Pp. xiv + 370. (Peiping: The French Bookstore, 1934.) Cloth, 3 dollars; paper, 2.40 dollars.

THE publication of an English edition of this book simultaneously with the Chinese text will be welcome to many foreign botanists and others interested in the trees of the district around Peiping. The author claims to include only the more common species occurring in the Province of Hopei, and this object has been fully attained. The Englerian system of classification is adopted. Useful keys to the families, genera and species respectively are supplied. From these, in conjunction with the descriptions, the student should in most cases have little difficulty in naming the trees met with in this part of China. Taxonomic works published in China in recent years have been noted for the high standard of illustrations from line drawings, and in the present work Mr. C. R. Feng has maintained this high standard in illustrating practically all the species which Mr. Chow describes here. The distribution of each species is given and under the heading "Use" are, in many cases, a number of interesting notes. The book is clearly printed, but there is no index. C. V. B. M.

Chemistry

Theoretische Grundlagen der organischen Chemie. Von Prof. Walther Hückel. Band 1. Zweite Auflage. Pp. xii + 475. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 19.80 gold marks.

A LITTLE more than three years ago the first edition of Prof. W. Hückel's "Theoretical Outlines of Organic Chemistry" was published (NATURE, 129, 41; 1932) and now we have the second edition of the first volume of that work.

The present edition keeps generally to the original plan, but there have been minor and justifiable rearrangements. Prof. Hückel's critical survey of some modern work is stimulating, but stated so didactically may, and does, meet with many criticisms. The really disappointing feature of the present work is the omission of references to advances in organic chemistry which have been made during the last three years; these advances have been described, if only—and necessarily—briefly in the excellent "Annual Reports of the Progress of Chemistry" published by the Chemical Society, with a reasonably full bibliography. Incidentally, it is worth while recording that the cost of this new edition of Prof. Hückel's book is rather more than six times the cost of any one volume of the "Annual Reports".

The appearance of finality which the written word is apt to convey is not in keeping with the publication of new editions of such works at very short intervals. Provided that the first or original edition is well planned, and this is certainly true in the case of Prof. Hückel's book, it is suggested that such rapid republication is unnecessary and it is certainly to be deprecated. C. S. G.

Conductometric Analysis: Principles, Technique, Applications. By Dr. Hubert T. S. Britton. (Monographs on Applied Chemistry, Vol. 8.) Pp. xi + 178. (London: Chapman and Hall, Ltd., 1934.) 12*s.* 6*d.* net.

THIS book is a smaller and more specialised companion to the author's volume on "Hydrogen Ions", published in the same series. After two short introductory chapters on the nature and significance of electrical conductivity, apparatus and methods are described in chapters iii and iv. The rest of the volume is devoted to various applications of conductometric titration.

Since the author maintains that "the conductivity of solutions can often supply useful information which cannot always be easily obtained by other means", it may be anticipated that this clear and well-produced exposition of the subject will have an extensive circulation If it be maintained that the methods advocated are suitable only for "pure research", it may be recalled that exactly the same remarks were probably made about pH determinations some twenty years ago The determination of hydrogen ion concentration is, however, at least as frequently carried out to-day in industrial as in academic laboratories, and Dr Britton's book should do much to bring about a similar extension of use for conductometric analysis A L B

(1) *Introductory Colloid Chemistry* Pp xiv + 198 15s 6d net (2) *Laboratory Manual of Colloid Chemistry* Third edition, rewritten and reset. Pp xvii + 229 20s net By Prof. Harry N Holmes (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1934)

THE author's introductory text fulfils its claim to be a "short, clear, yet moderately comprehensive statement of the fundamentals of colloid chemistry" In fairly brief compass he has discussed the preparation and fundamental properties of various colloid systems, coagulation, froths and films, emulsions, gels and jellies, soaps, proteins, soils and clays, adsorption and catalysis The value of the work is enhanced by a series of well-selected references

The companion laboratory volume has now reached its third edition a fact which testifies sufficiently well to its usefulness

Laboratory manual and textbook are developed on closely parallel lines, and the manual is also enriched by a large number of references to the original literature

The author has preserved his enthusiasms, and his presentation of his subject shows an admirable combination of freshness and conciseness. A F.

Engineering

Elements of Water Supply Engineering By Prof E L. Waterman. Pp. xv + 302 (New York · John Wiley and Sons, Inc., London : Chapman and Hall, Ltd , 1934) 21s 6d net

THIS work is stated by its author, who is professor of sanitary engineering in the State University of Iowa, to be a textbook for students beginning their study of water supply engineering, he disclaims that it is in any sense a treatise or a handbook. He has based it on lectures which he himself delivers and it is designed to suit the particular need of his students. Viewed from this angle, the book fills a definite purpose in regard to which the author is naturally sole arbiter, and so, although the science of hydraulics is an essential element of water supply engineering, the theoretical side of the subject, with its fundamental laws, is excluded from consideration, as being adequately treated elsewhere, and, in the case of the author's students, being taken in a concurrent course

Subject to these limitations, the volume forms a very useful introductory survey of American practice in water supply In addition to the purely technical features (reservoirs, pipes, channels, intakes, pumps and pumping plant), the communal, sanitary, chemical and financial aspects of the matter are dealt with As the purview of the work is confined to the North American continent, it contains certain things which present some degree of strangeness and novelty to English engineers For example, the *per capita* consumption of water in the leading cities of the United States is startling when compared with the standards of Great Britain One wonders what it can be used for and whether there is not excessive waste Whatever be the explanation, it is certainly instructive to have the practice of other nationalities displayed for comparison and study, and English engineering students will find the book very helpful in this respect, as in others of a more general character. B C

The Blue Book 1935 · the Directory and Handbook of the Electrical and Allied Industries 53rd edition Pp xxviii + 1436 (London Benn Brothers, Ltd , 1935) 25s net

THE fifty-third annual edition (1935) of the electrical trades directory and handbook will prove of value to everyone who wants to have the latest information about the activities of the electrical engineering profession and industry In this edition more societies, associations and technical schools and colleges are included Many physical constants connected with industry are given, and we were interested in an instructive page on telephone transmission units. The difference between the American standard line of cable and the English standard line is clearly explained and the decibel and neper are defined Useful particulars are given about the Bureau of the International Communication Union The grid scheme of the Central Electricity Board was completed last year, and grid tariffs for the whole of Great Britain, except south Scotland and north-east England, are in operation In the manufacturing industry a fairly general and sustained improvement occurred during 1934 The output of electricity by supply undertakings increased 14 per cent compared with the previous year The use of broadcasting and telephony has also greatly increased

Wireless for the Man-in the-Moon Perhaps a Fairy Tale, Perhaps a Textbook, Perhaps Neither By Coulombus and Decibel Pp 128 (London . George Newnes, Ltd , 1934) 2s 6d net.

JOHN PERRY was wont to say that Euclid was fit reading only for the very learned This work of 'Coulombus' and 'Decibel' falls, not necessarily for the same reasons, into the same category If the man-in-the-moon is very learned he will take no harm from the reading, and may contrive a rare wan smile, but he will learn little or nothing He will certainly wonder whether life is made notably easier by the simple device of calling an electron a duckling If, on the other hand, he is the simple soul at or to whom the "wit and humour of the book" (guaranteed by the publishers) are directed, he may be deluded into feeling that he has "unconsciously acquired a real insight into the basic principles and practice of Wireless"

Mathematics

Differential and Integral Calculus, By R Courant Translated by E F McShane Vol I Pp xiii + 568 (London, Glasgow and Bombay Blackie and Son, Ltd, 1934) 20*s* net

THIS volume is an English edition of the author's original work in German on the calculus which was briefly reviewed in 1928 Although the title page announces it to be a translation, yet it is much more than this Dr McShane, in co-operation with the author, has considerably modified the treatment in order to adapt the book to the needs of English and American students Among the principal divergencies from the original text, this edition contains (i) a sketch of the differentiation and integration of functions of several variables, and (ii) a collection of classified examples Although the preface claims that a large number of exercises has been added, yet, compared with English textbooks, this number is somewhat small

The course is intended for those who wish to pursue the study of the calculus and its applications as beginners Much of the rigour demanded in establishing some of the more difficult fundamental theorems has therefore been taken out of the main discussion and given later in appendixes to the chapters In this way, not only is the student enabled to pass rapidly to the practical applications, but also the presentation of the subject has been greatly enhanced, for too much rigour to a beginner is undoubtedly repellent

The book is thoroughly well printed and the text is of a clarity which is not always possible in a purely literal translation F G W B

Higher Mathematics for Engineers and Physicists By Prof Ivan S Sokolnikoff and Dr Elizabeth S Sokolnikoff Pp xiii + 482 (New York and London McGraw-Hill Book Co, Inc, 1934) 24*s* net

THE text of this volume is based upon courses of lectures given annually to engineering students in the University of Wisconsin The aim of the authors is to provide a textbook which may not only appeal to students of applied science, but may also serve as a stepping-stone to more advanced mathematical treatises A wholly rigorous and purely formal presentation has therefore not been attempted, since, as the authors wisely point out, such a course of detailed analysis would tend to bewilder many practical students and thus stifle their interest in mathematics

The calculus, beginning with elliptic integrals and leading on to those ordinary and partial differential equations most frequently met with, is thoughtfully developed This is followed by some very practical chapters on vector analysis, probability and empirical formulæ, whilst the final chapter incorporates an interesting lecture on conformal representation by Dr Warren Weaver Examples are provided at the end of each chapter, and these are to be regarded as an integral part of the text, since they embody extensions and further developments of the subject matter.

A Shorter Trigonometry By W G Borchardt and the Rev A D Perrott Pp viii + 238 + xxxii + xxxi (London G Bell and Sons, Ltd, 1934) 4*s*, without Tables, 3*s* 6*d*

As the title suggests, all the trigonometry for the several school certificate examinations is here contained in a single volume The authors have divided the text into two parts the first is introductory and therefore mainly numerical, the second deals with the more formal trigonometry The whole treatment is thoroughly sound, and every chapter contains a large number of exercises which are well designed to stimulate the pupil's interest and are not too difficult

Objection might be taken to the statements on p 86, where confusion is likely to arise in identifying cosA and sinA, previously defined as ratios, with the *lengths* of OM and PM respectively In spite of this small defect, however, the book may be confidently recommended, for the authors have carried out their purpose excellently F G W B

Miscellany

Three Philosophers (Lavoisier, Priestley and Cavendish) By W R. Aykroyd Pp. xi + 227 + 8 plates (London William Heinemann (Medical Books), Ltd, 1935) 10*s* 6*d* net

THIS is a rather charmingly written study not too deep, not heavy, not coldly ordered, and humane With the central figure Lavoisier are portrayed (with sound art in passing to and fro between the characters) Priestley and Cavendish, as complements and foils Cavendish, by birth noble, by inheritance wealthy, by genius a metrical hermit, and Priestley, the very opposite in each point, in whom an intolerable fluency in doctrine was joined with the happiest success in qualitative experimenting these two men are quite indispensable to science, yet both humanly and scientifically they stand at antipodes That third indispensable, Lavoisier, was equipped with a supremely lucid and systematising brain, and he commanded much of Cavendish's type of metrical skill, coupled (for scientific purposes) with Priestley's missionary instinct *minus* its naïvety Hence, though he lacked their peculiar gifts for discovery *per se*, he was able with this triple combination of abilities to rise to a summit higher than either of theirs.

Mr Aykroyd does not hide Lavoisier's "grabbiness" (as he calls it) in adding to his considerable wealth, and in the familiar points of scientific priority But he shows well that Lavoisier toiled greatly for the material civilising of a dirty and misgoverned nation, and that this public service came to take far more of his energy and time than did his scientific researches Nevertheless in the end it failed, as they did, to save him in '94 from the inevitable fate of the ci-devant tax-farmers The latter years of Lavoisier's life are especially well told, and the mounting crises of the time, and the author's pleasant humour enlivens his sketch of Mme Lavoisier's essay in second marriage with Count Rumford

It is not to this work that chemists and physiologists would turn for authoritative history of their sciences, for that is scarcely the author's intention; but it will appeal to them, and no less to lay readers, because it shows well the diversity of the human agents through whom scientific discovery grows

IRVINE MASSON

Hutchinson's Technical and Scientific Encyclopædia Terms, Processes, Data, in Pure and Applied Science, Construction and Engineering, the Principal Manufacturing Industries, the Skilled Trades with a Working Bibliography Edited by C F Tweney and I P Shirshov In 3 vols Vol 1 *A to Direction-Finding* Pp viii+672 (London Hutchinson and Co (Publishers), Ltd, n d) 28s

A DYSPEPTIC reviewer once grudgingly concluded his notice of a book with the words, "We have not detected any errors, but no doubt there are some" In a work of the comprehensive range of this "Encyclopædia", it is almost inevitable that there should be sins of omission or of commission, but our attitude towards such an enterprise is one of admiration for what has been so well done rather than of finding faults in it The work is, however, not so much an encyclopædia as an encyclopædic dictionary Though a fair number of the articles may rightly be described as encyclopædic in character, most of the entries are of the nature of definitions or explanatory paragraphs relating to words and terms which make up the vocabulary of science and technology

The editors, with the assistance of about eighty principal contributors, have been successful in their treatment of a very wide field, and few points appropriate to the survey have escaped notice, even if they have only recently emerged Thus, we find definitions or explanations of such subjects as bel and decibel, ascorbic acid and carotene as vitamins, Cepheid variables, and cosmic radiation We miss cytology, and though chromosphere is included we do not find chromosome, also deuterium and diplogen occur but not diplon, and dingo but not dinosaur. These, however, are but minor points, and we have no hesitation in saying that the editors and the publishers deserve the thanks of all who are engaged in scientific or industrial occupations for this handy and helpful work of ready reference We trust the two further volumes will maintain the same high standard.

Scrambles in Japan and Formosa By the Rev W H Murray Walton Pp 304+26 plates (London Edward Arnold and Co, 1934) 18s net

BOOKS on Formosa are relatively few, and this one treats of the little known mountainous part of that island, much of which is still only nominally under Japanese control The hill tribes were left alone by the Chinese, but are gradually being subdued by the Japanese There is a brief sketch of the habits of these 'head hunters', and a great deal about the rugged peaks of the island, including Niitaka, which rises to well over twelve thousand feet After the ascent of these and other lofty peaks, Mr Walton returned to Japan and climbed in the Japanese Alps There is an interesting chapter about the island of Yakushima and its forests and people It is, however, in respect of the attention it gives to Formosa that this book has its chief value There are useful maps and many photographs

Alpine Pilgrimage By Dr Julius Kugy Translated by H E G Tyndale Pp xxii+374+20 plates (London John Murray, 1934) 12s net

IN this volume a well known mountaineer summarises the work of forty five years, mainly in the Carnic and Julian Alps It is a book that should delight not only climbers but also all who care for mountain scenery and alpine pastures, for Dr Kugy writes with equal charm of the hills, the flowers and the animal life. The technique of climbing interests him little and he claims to have written neither a climber's guide nor a book of sport Achievements, though he could claim many, do not impress him To him the charm of mountaineering lies in the solitude and beauty, and he abhors the dedication of Alpine heights to record breakers, and tourists with provisioned huts and inns and mountain railways There are many fine photographs and a useful map The book should delight all mountaineers

Philosophy and Psychology

The Family its Sociology and Social Psychiatry By Prof J K Folsom (Wiley Social Science Series) Pp xiii+604 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1934) 25s net

THE development of modern society in the post-War period has been denounced as thoroughly immoral and degenerate, it has been justified as an expansion of the opportunity for self expression Dr Folsom studies the function of the family as an integral part of society and, without expressing an ethical judgment, diagnoses the changes in the circumstances and conditions affecting it as part of this development, according as they conduce to or hinder the proper performance of its function in a healthy community Conduct which in the ethical judgment would be regarded as immoral, that is, not in accordance with the conventions of modern civilised society, is classified as a maladjustment

Dr. Folsom has here made a very thorough study of his subject. The family is examined first as a means of satisfaction for certain human needs; it is then surveyed as a working system, and the differences in the family of the savage and the civilised man are contrasted with the view of showing what the function of the family may be in differing circumstances. The changes which are taking place in romantic love, courtship, sexual relations, married life, divorce, irregular unions, the relations of parents and children and so forth, are then surveyed in the light of the data which have been collected both in Europe and in the United States. Much of this material is familiar in a general way, even to those who have not made a special study of the subject; but it is here set forth in convenient form and discussed quite impartially by the author. A considerable part of the book is devoted to a practical application of the conclusions which the author has reached, with the view of alleviating or remedying certain of the maladjustments which experience shows now enter into the social problem.

Science and Monism. By Dr. W. P. D. Wightman. (History of Science Library.) Pp. 416. (London: George Allen and Unwin, Ltd., 1934.) 15*s*. net.

DR. WIGHTMAN makes a rapid survey of philosophical speculations concerning the character of the universe as a whole from Thales to Whitehead and of their interaction with physical theory. Biological theory too he takes in his stride. It is a little breathless and too much of it merely summarising other people's summaries; but he is always clear and obviously has the capacity to seize on the essentials. His comments, where he allows himself any, are pertinent and pointedly expressed. Where he is dealing with thinkers he understands thoroughly, as Spinoza, he is an excellent exponent and critic.

At the end, however, it is difficult to suppress certain doubts. We may take monism in a loose sense as meaning no more than that there is a wholeness of things within which events happen with some recognisable order, or in other words that though we may expect some surprises we are not always being surprised. In this sense, monism has always been the principle inspiring scientific investigation and speculation. But if this were all, there would be no need to write a book about it. Monism evidently means more than this for Dr. Wightman, as it has for everybody, and it is doubtful whether any strict kind of monism is compatible with empirical science. If the universe is really in any way compact and homogeneous, then we cannot know anything truly about any part until we know about the whole, and if we know anything at all, in principle at least, we know everything. Consequently scientific procedure, which consists in finding out about the parts without troubling about the whole, is fallacious and unnecessary, as Hegel and some of his followers appear to have thought. Perhaps Dr. Wightman will next consider whether some kind of dualism or pluralism is not an essential postulate of science.

Philosophical Studies. By the late Dr. J. McT. Ellis McTaggart. Edited, with an Introduction, by Dr. S. V. Keeling. Pp. 292. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

THE day has gone when a book of philosophical studies, even though its author was distinguished only as a metaphysician, is to be regarded as necessarily outside the province of a scientific journal. The frontiers between science and metaphysics are no longer so rigidly drawn as they were a generation ago. Science may shade off into metaphysics, and metaphysics may be informed with the scientific spirit. McTaggart, for example, insisted that there is only one way of getting at the truth, and that is by proving it. He would have nothing to say to the doctrine that a thing must be true because we want it to be, except that such doctrine is "false and rather cowardly". There spoke the man of science, though not of physical or biological science. Again, he was lucid and definite in his broad demarcation between the aims of metaphysic and of science. The former is concerned with the ultimate nature of reality; the latter is also concerned with reality, but not with its ultimate nature—a definition which is something to go on with, but perhaps not to be maintained to the end.

The papers collected in this volume, under the extremely able editorship of Dr. Keeling, give an interesting summary of McTaggart's philosophical method and conclusions, and would serve as a good introduction to the study of his chief published works. We quite agree with the editor that the paper entitled "An Introduction to the Study of Philosophy" is an outstanding example of philosophical summarising. It is well worth the careful attention of all who are interested in the borderland between science and philosophy, as well as of those whose main interest is in philosophy.

Must Philosophers Disagree? and other Essays in Popular Philosophy. By Prof. F. C. S. Schiller. Pp. xi+359. (London: Macmillan and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THE essays in this collection, like all Dr. Schiller's work, are amusing and provocative, and sometimes more than this. The three essays on William James and his work, coming from a fervent admirer, are interesting and valuable. Many who do not agree with James's philosophy would yet agree with Dr. Schiller that he is one of the creative thinkers of modern times. Perhaps the most interesting part of the book are the four connected essays called "A Philosophical Survey"; the last of which is on "Man's Future on the Earth". The author makes the useful point that at any moment there are some factors making for improvement and others for deterioration; so that a survey of present conditions, with the future unknown, provides equally good arguments for optimists and pessimists. There has been progress, but not always, or in straight lines, and it is always precarious.

Your Mind and Mine an Account of Psychology for the Inquiring Layman and the Prospective Student By Dr. Raymond B Cattell Pp 314 (London, Bombay and Sydney George G Harrap and Co, Ltd, 1934) 7*s*. 6*d* net

Dr. Raymond Cattell, who is psychologist to the Leicester City Education Committee, provides us in "Your Mind and Mine" with a very sensible account of psychological problems of to day. The book is charmingly written, easy to read, and will appeal to those who have to read without being in possession of technical knowledge The epoch making work of Spearman and Burt receives full consideration

We doubt the wisdom of illustrating stigmata of degeneration, having stated in the text that they are practically as common in the general population as among criminals A little knowledge is indeed a dangerous thing, and the public are very quick to air their little knowledge on so many occasions

Physics

Newton and the Origin of Colours a Study of one of the Earliest Examples of Scientific Method By Michael Roberts and E R Thomas (Classics of Scientific Method) Pp viii+133+8 plates (London · G Bell and Sons, Ltd, 1934) 3*s* 6*d*. net

It is something of a reproach to physical science that very little has heretofore been accomplished in the matter of historical teaching Chemistry, to its great benefit, has adopted another course, and systematic lectures on the history of the science have been a commonplace for generations More than ever to-day, when the foundations of physics are being laid anew, is it necessary to approach our science historically, and thus to realise something of what the builders of the older structure thought of its permanence and its value To attempt a valuation of some one portion of the whole fascinating story in anything like a compact volume is perhaps even more difficult than to tell the full tale. A full and accurate survey of the documents involved may leave one without a picture, and it is above all essential that the characters should be set against the background of their times, and that those little details—*ce superflu, si nécessaire*—should be sketched in, which make all the difference between the vivid and the dull outlook

The authors of "Newton and the Origin of Colours" must be held to have succeeded in this by no means easy task. They have told us something of Newton, of his predecessors and contemporaries—of Robert Hooke "of middling stature something crooked, pale faced, and his face but little below, but his head is lardge, his eie full and popping, but not quick, a grey eie". They have given us an outline of the state of optics in 1660, of Newton's contributions to optical science, of the controversies with Hooke and with Linus, and of the developments of optics since Newton. They have accomplished this feat in a well-written octavo of some one hundred and thirty pages. The volume is a notable contribution to an excellent series. A. F

Ions, Electrons and Ionizing Radiations By Prof J. A Crowther Sixth edition Pp xi+340+4 plates (London Edward Arnold and Co, 1934) 12*s* 6*d*. net

This is a sixth edition of the well known textbook so familiar to university students of physics, and in the preface the author explains the reasons for the new edition and the manner in which it differs from its predecessor

The limitations set on the subject matter are generally indicated in the title, but as Prof Crowther points out, the very rapid advances within the last few years have necessitated much rewriting and also considerable change in the balance between the older and the newer knowledge The reader familiar with an older edition will at once recognise such main sections as those on the charge on an ion, photoelectricity, X rays, and so on He will also be pleased to note new sections on neutrons, positrons, cosmic radiation, artificial disintegration and structure of the nucleus

These sections are of course written in the author's usual lucid style, and the selection of subject matter is admirably suited to his chosen scope and object, namely, the introduction of students grounded in physics to the more recent developments

In consonance with this aim, there has been no attempt to give more than general references at the end of each chapter—a wise provision which makes it easier for the student to follow up selected topics. The book cannot be said to be overloaded with theory—the subjects being treated, on the whole, in that broad manner likely to be acceptable to science students generally

Certainly the student who works through Prof Crowther's excellent book will attain to a sound general knowledge of the experimental bases of modern physics

The Physical Basis of Things By Prof John A Eldridge (International Series in Physics) Pp xiv+407 (New York and London McGraw Hill Book Co, Inc, 1934) 22*s* 6*d* net

The author has given, in an interesting style, a vivid account of the physics of to day As he says, the book is not primarily intended for the specialist in physics but rather to give the student an appreciation of modern physics The atom takes, of course, the main position, and relativity a subsidiary one After opening with relativity, a large section on the kinetic theory of matter follows This is particularly good in showing how the statistical method runs through the whole subject. The quantum theory and its pre-spectrum applications follow The spectrum is described in more detail than any other phenomenon This is perhaps justified, but the reader will find that the style of interesting narrative has at this stage become lost in a catalogue of spectrum series, energy levels and electron spin, to be regained, however, when nuclear physics is reached Here the transformation of atoms is described, along with the discoveries of the deutron, neutron and positron In view of the importance of these discoveries, they might have been described at greater length The new mechanics is not treated with the same wealth of detail as the earlier subjects This is reasonable, as the book is in no sense a mathematical treatise The table of relationships between the atomic and the C G S units is useful, and the student can exercise himself and at the same time revise his knowledge by working through the set of some 150 questions at the end of the book

Elementary Dynamics for Students of Science and Engineering By Dr R C Gray Pp xi+211 (London Macmillan and Co, Ltd, 1934) 5*s*

THIS little volume has been specially written for students beginning a university course in engineering or applied science It aims, therefore, at giving a useful introduction to the principles of applied dynamics The subject matter is divided into two main sections one dealing with the particle, and the other with rigid bodies The latter ends with a very valuable chapter on gyroscopes The whole course is not only well arranged, but also abounds in practical applications, which are clearly explained and quite interesting

The mathematical side has only been dealt with so far as is necessary in the discussion of the principles underlying applied science The author points out that no calculus has been used as few students have previously studied it The book is well supplied with suitable exercises of a practical nature, and these are chiefly arithmetical Although the mathematical treatment is slender -and not without some very faulty statements -the course is quite a good one and admirably suited to the needs of the students for whom it was written

The Kinetic Theory of Gases being a Text and Reference Book whose Purpose is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator By Prof Leonard B Loeb Second edition Pp xx+687 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1934) 36*s* net

STUDENTS of the generation which fared dryly on such treatises as Watson's would scarcely recognise their subject in the new edition of Prof Loeb's treatise The classical developments are all there for the nourishment of the student of the elements, but due regard has been taken of the astonishing changes which we associate with the name of quantum mechanics At least a third of the original text has been rewritten, and the sections which deal with specific heats, with equations of state, with dielectric constants and with magnetism, have suffered radical changes

The book needs no description or recommendation to students of kinetic theory, and it is sufficient to say that, in its revised form, it amply fulfils its claim to be a "Text and Reference Book whose Purpose is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator" A. F

Lumineszenz-Analyse im filtrierten Ultravioletten Licht ein Hilfsbuch beim Arbeiten mit den Analysen-Lampen Von Prof Dr P W Danckwortt Dritte, erweiterte Auflage, mit einem Beitrag von Dr J Eisenbrand uber "Quantitative Messungen" Pp viii+190+16 plates (Leipzig Akademische Verlagsgesellschaft m b H, 1934) 8 50 gold marks

THE first edition of Prof Danckwortt's book appeared in 1928, and the third is mainly distinguished from its predecessor by the addition of an entirely new section on the quantitative measurement of fluorescent radiation emitted by bodies when exposed to ultra-violet light, contributed by Dr J Eisenbrand, and a further list of references to original work The apparatus and technique for qualitative observations, photography, microscopy and photomicrography are fully described The excellent set of plates included in the book bears witness to the wide range of usefulness of ultra-violet light examinations, and the thousand or so references to original papers emphasise the need of a guide such as this book provides

Technology

Photo Engraving By A J Bull Pp viii+100+15 plates (London Edward Arnold and Co, 1934) 9*s* net

THIS is an excellent little book It has been written with the object of providing a concise but accurate account of the various methods of photo-engraving It is intended for students, for those who are in the printing trade and may be familiar with one branch it will serve to provide a general survey of their craft, and for a wider class of students it will teach the outlines of the various methods so that their own work may be more fruitful The latter group will include advertisers, commercial artists and others who must use photo-engraving as a means to their particular ends The author's experience, both as a teacher and a research worker, has enabled him to make the book a model of clarity To the general reader, not the least interesting part is the historical outline of the application of photography to printing

The Kingdom of the Camera By T Thorne Baker. Pp xvii+209+64 plates (London G Bell and Sons, Ltd., 1934) 7*s*. 6*d* net

THE applications of photography to general science and industry have now become so numerous that few people, even among those who use photography in their daily work, have any idea of the vast variety of its possibilities For many years Mr. Thorne Baker has been associated with photographic inventors and their work, moreover, he can write a good story about things he has met with in his wide experience. In this exuberant book he gives a short survey of most of the outstanding applications of photography. Profusely illustrated with good half-tone plates, it provides a very interesting, though necessarily very brief, account of the subject.

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Experimental Evidence regarding the Field of the Deuteron

A METHOD for determining the field surrounding nuclei is to scatter charged particles by the nuclei in question. If the field were of the Coulomb type, the yield of nuclei projected in a given direction under the bombardment of α particles would be proportional to $1/V^4$, where V is the velocity of the incident α-particles Any deviation from the Coulomb field will manifest itself in a deviation from this relation The experiments of Chadwick and Bieler[1] have shown that such anomalous scattering is very clearly evident in collisions between α-particles and protons for α-particle velocities corresponding to ranges greater than about 2 cm

We have made similar experiments to determine the range at which anomalous scattering begins for α-particle impacts (1) with protons, (2) with deuterons Our results for protons confirm the work of Chadwick and Bieler and show detectable anomalous scattering at 1 7 cm α-particle range for head-on collisions; experiments at a greater angle showed that the anomaly occurs at a larger range but for the same distance of closest approach The yield curves for deuterons are of the same form as for protons, as suggested by Rutherford and Kempton[2], but the anomaly begins at a lower α-particle range, namely, 1·45 cm for head-on collisions

If one calculates the distance of closest approach for the two cases, taking account of the different masses of the projected particles, one finds that the deviation from the Coulomb field occurs at $4\ 6 \times 10^{-13}$ cm for protons and $3{\cdot}1 \times 10^{-13}$ cm for deuterons It is of interest that the attractive nuclear field extends farther in the case of the proton than it does in the case of the deuteron If known corresponding radii for higher elements are plotted against Z, then it is the proton which lies off the extrapolated curve, the deuteron being more nearly regular

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[2] Rutherford and Kempton, *Proc Roy Soc*, A, **143**, 724, 1934

β-Spectra of Some Radioactive Elements

WE have investigated the β spectra of radioactive elements that are obtained by bombarding chlorine, bromine and iodine with neutrons As E. Fermi, E. Amaldi, O D'Agostino, E Rasetti and E Segré[1] have shown, in all these cases radioactive isotopes of the bombarded elements are formed

A glass tube containing beryllium and 200 millicuries of radon was used as the source of neutrons. Surrounding the source with substances rich in hydrogen[2] highly increases in the case of bromine and iodine the probability of formation of the radioactive nuclei, and in the case of chlorine gives a marked effect[3] Therefore we immersed the source, together with the sample to be irradiated, in a container filled with water

Radioactive chlorine was observed by using carbon tetrachloride, and radioactive bromine and iodine were obtained from ethyl bromide and methyl iodide, the active atoms being separated from the irradiated substance, as suggested by Szilard and Chalmers[4], in the form of a thin layer of the corresponding silver compound.

The energy distribution of the electrons emitted was measured by the magnetic analysis method with two Geiger-Muller counters already described[5] The results obtained are shown in the last two columns of the following table

Irradiated substance	Radioactive substance	Period	Limit of the spectrum	Maximum of the spectrum
Chlorine	Cl^{38}	50 min	2,050 ± 100 kv	—
Bromine	Br^{80}	30 min	2,100 ± 100 kv	~ 500 kv
Bromine	Br^{82}	6 hr	2 100 ± 100 kv	< 300 kv
Iodine	I^{128}	30 min	2,100 ± 100 kv	~ 500 kv

So far as the accuracy of our measurements goes, all the elements investigated have the same spectral limits. Furthermore, Br^{80} and I^{128} have not only the same periods and spectral limits, but also the same shape of the spectral curve, analogous to that of radium E By comparing the spectral limits obtained here with the masses of the nuclei involved in the nuclear reactions, emission of hard γ-rays is to be expected

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[1] E Fermi, E Amaldi, O D'Agostino, E Rasetti and E Segré, *Proc Roy Soc*, A, **146**, 483, 1934
[2] E Fermi, E Amaldi, B Pontecorvo, E Rasetti and E Segré, *La Ricerca Scientifica*, V, **2**, 1934
[3] E Amaldi, O D'Agostino, E Segré, *La Ricerca Scientifica*, V, **2** 1934
[4] Szilard and Chalmers, NATURE **134** 462, 1934
[5] A J Alichanow, A I Alichanian and B S Dželepow, NATURE, **133**, 950, 1934

Ionosphere Measurements during the Partial Eclipse of the Sun of February 3, 1935

PULSE measurements were made at Deal, N J, during the solar eclipse of February 3, 1935 This eclipse began at 10 28 a m and ended at 12 32 p m with a maximum effect at the ground at Deal of approximately 40 per cent magnitude at 11 30 a m. (E S T)

The critical ionisation frequencies for the E, M^1 and F_2 regions were measured on the day of the eclipse from 8 30 a m to 2 00 p m as well as on the two following days

Our results show that the eclipse was accompanied by a decrease in the maximum ionic density of 20 25 per cent in all three regions, and that the minimum ionisation occurred at or very shortly after the eclipse maximum The percentage decrease was progressively greater from the lowest to the highest region, being approximately 20 per cent for the E region, 22 per cent for the M region and 25 per cent for the F_2 region. A progressive increase of this order is to be expected from the fact that the eclipse had a magnitude of 40 per cent at the ground and approximately 43 per cent in the F_2 region (250 km over Deal) These magnitudes are in terms of the sun's diameter, which for this eclipse means an eclipsed area of 29 and 31 per cent, respectively

This decrease in ionic density may be compared to a 50-60 per cent decrease in the E region ionisation during the eclipse of August 31, 1932, when the eclipse magnitude was 95–100 per cent

A number of observers[2] who made measurements during the 1932 eclipse agreed that while there may have been an eclipse effect in the F_2 region, it could not be definitely attributed to the eclipse in view of the variable nature of this layer on days before and after the eclipse and because the effect which was found was not coincident with the solar effect but was considerably later

The present measurements seem to give a more definite correlation between the eclipse occurrence and the time of decrease in ionic density of the F_2 region, in that the decrease began within a few minutes after the first contact, with a minimum shortly after the maximum of the eclipse and a recovery to a more or less constant higher value a few minutes after the last contact At no time during these measurements on the eclipse day or the days after was there any other variation of a comparable magnitude

It must be remembered, however, that the F_1 region is of a very variable nature and it will take many eclipses before we are absolutely sure of the effect produced upon it

These results, together with the results of the August 31, 1932, eclipse, indicate that ultra-violet light is an important ionising agency in the E, M, F_1 and F_2 regions

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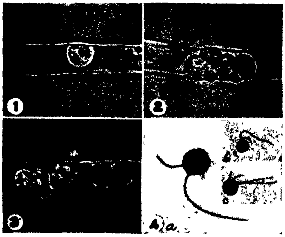
[1] This is the intermediate region see Schafer and Goodall, NATURE, **131**, 804, 1933

[2] Kirby, Berkner, Gilliland and Norton *Proc I R E*, Feb, 1934 Henderson, *Canadian J Research* January, 1933 Schafer and Goodall, *Science*, Nov 11, 1932

Occurrence of Zoosporangia in *Spongospora subterranea*, (Wallroth) Lagerheim

ALTHOUGH powdery scab disease of potatoes has been known and studied for nearly one hundred years, zoosporangia have never been described in the life-history of the causal organism, *Spongospora subterranea*. Zoosporangia have, however, been observed in other genera of the Plasmodiophorales by Cook[1] and by me[2] It therefore seemed probable that they might be found in *Spongospora*, especially if microscopic examinations of the roots of the host were made early in the course of the disease.



FIGS 1–4 *Spongospora subterranea* Fig 1 Early stage in zoosporangial formation in root hair of tomato, × 1,000 Fig 2 Zoospore discharge about to begin Note swelling on cell-wall of root hair, × 1,000 Fig 3 Zoospores being discharged, × 1,000. Fig 4 Stained zoospores, *a*, × 2,200, *b*, × 1,000, *c* (zygote ?), × 1,000.

Tomato and potato seedlings were planted in soil which, after steam sterilisation, had been inoculated with spore balls from diseased tubers. At 65° F heavy infection was obtained in two weeks in the root hairs of both hosts All stages of development from amœbæ which had just penetrated the host to mature zoosporangia were observed Sometimes single zoosporangia were present in root hairs or epidermal root cells (Fig 1) More often they lay in rows or clusters (Figs 2 and 3), sometimes of a dozen or more, nearly filling the host cell Development of a single zoosporangium to form a cluster appears to take place by a process of budding

Zoospore discharge is not accomplished through exit tubes but through a rupture in the host cell-wall resulting from pressure from a swelling which develops at one point in the zoosporangium (Fig 2)

Zoospores from zoosporangia are similar to swarm-spores from germinating spore balls in size, shape, ciliation and manner of swimming It is of interest to note that the occurrence of two cilia of unequal length confirms former observations on ciliation of zoospores in the Plasmodiophorales[3] The presence of occasional binucleate spores with four cilia (Fig 4c) suggests a possible fusion of gametes Further studies are being made on the origin and subsequent development of these

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[1] *Trans British Myc Soc*, **11**, 196–218, 1926, and *Proc Roy Soc*, B, **218**, 283–314, 1930

[2] *Phytopathology*, **23**, 20, 1933 (Abstract)

[3] NATURE, **133**, 534, 1934.

An Abnormality in the *Boyau Calicial* (Female Accessory Glands) of the Desert Locust, *Schistocerca gregaria*, Forsk.

WHILE dissecting out the ovaries of the desert locust, *Schistocerca gregaria*, some time ago, I came across an abnormality in the accessory glands which is worth recording

Normally, the *boyau calicial* in *Schistocerca gregaria*, as in all other Acrididæ (vide Fedorov[1], Fenard[2] and Uvarov[3]), consist of a pair of unbranched forward prolongations of the two egg-calyces anterior to the base of the first ovariole. Each *boyau* is a much-coiled structure and usually bends inwards to touch its fellow of the other side As Fenard[2] had observed long ago, these glands acquire their maximum development shortly before oviposition and "secrete a substance which is destined to be extruded at the same time as the eggs" This substance is the material which forms the basis of the egg-pod, and also forms a protective 'froth' over the eggs In the uncoiled condition the glands are about 3 mm long in a freshly emerged female and 8–12 mm long in a female about to lay eggs.

The abnormality of the glands in the present case consists in the fact that the right gland shows an extra diverticulum arising from its outer side at a point about one third the length of the gland from its anterior tip It reaches forward beyond the latter. The length of the main gland is about 4·8 mm. and that of the diverticulum 3 mm The latter has exactly the same appearance as the main gland and shows similar folds The left gland of this female is normal. The female in which this abnormality has been found is a young one, as is evident from the small size of the ovarioles and of the accessory glands

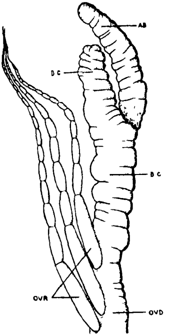

FIG 1 The right female accessory gland of *Schistocerca gregaria* Forsk, showing the abnormal outgrowth Camera lucida drawing × 12 *AB*, abnormal outgrowth of the gland *BC*, female accessory gland *OVD*, egg-calyx, *OVR*, ovarioles

I had previously dissected more than a hundred females of this species but never encountered any abnormality in the accessory glands, nor, so far as my knowledge goes, has such an abnormality been recorded in any other Acridiid.

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[1] *Trans Ent Soc Lond*, **75**, 1927
[2] *C R. Acad Sci*, **22**, 1896
[3] "Locusts and Grasshoppers" London, 1928

Crown Rot of Sugar Beet a Boron Deficiency

CROWN rot of sugar beet and mangel is an unsatisfactory disease to account for, and some doubt has always attended the attribution of it to the fungus *Phoma betæ*, Frank It was not entirely surprising, therefore, that Brandenburg[1] has recently shown in Holland that the disease is caused by boron deficiency, and can be cured by the addition of this element, in the entire absence of the fungus This has now been confirmed in Ireland

In the first of the present experiments, ten sugar beet seedlings were grown in Crone's solution (pH 6·2–6·5) without boron, and 20 with the addition of 1 mgm. of boric acid per litre. The former developed crown rot rapidly and to such an extent that, after 30 days, three of them were dead and seven seriously diseased, while the latter grew normally and much more vigorously. At this stage the experiment was reversed, boric acid being supplied to the seven seriously diseased plants and withheld from ten of the twenty healthy ones The effect was immediate, for the former began to grow and produced secondary crowns, as in field attacks of the disease, while the latter developed crown rot The ten plants receiving boron throughout continued to grow well to the end Similar results were obtained using Tollens' and Knop's solutions There was no parasitic fungus associated with the disease

Confirmatory results were secured in two field experiments in Carlow where the disease is very severe locally The yield and value of the crop were about doubled in one case (where the attack was exceptional) and increased by one half in the other, the sugar content being raised by 1-3 per cent, by applications of 12-20 lb of borax per acre Heavier applications did not appear to give proportionate increases, but the disease is very unevenly distributed and the optimum rate of application has not yet been determined Brandenburg used about 18 lb per acre

The discovery has much economic importance Thirty per cent of the beet area of Leinster is said to be subject to crown rot, and as a result of this work the incorporation of borax with the fertilisers is being considered The addition of borax where the disease was absent showed no apparent effect, beneficial or otherwise

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[1] Brandenburg, E, *Phytopath Z*, **3**, 499 1931

Nomenclature of Vitamin B_2

PERHAPS it is useful to direct attention to the above subject before confusion gets worse confounded It was pointed out in 1931 that the use of the terms vitamin B_2 and anti-dermatitis (anti-pellagra ?) factor interchangeably was already causing difficulties[1] The discovery by Kuhn and his co-workers that lactoflavine is able to supplement a vitamin B_2-deficient diet for the growth of rats constitutes a great advance, but the anti dermatitis factor (the so-called *Haut-faktor* of the Heidelberg workers) does not appear to be identical with it Again, we have observed[2] that concentrates of renoflavine (obtained from ox-kidney extracts) have their growth-promoting effect considerably enhanced by the addition of a relatively heat- and alkali-stable substance present in ox-kidney extracts, which is not so well adsorbed by fuller's earth in acid solution as the flavine The tests were carried out with 'vitamin B' deficient rats receiving vitamins B_1 and B_2

The same heat stable factor in ox kidney extracts, which is obviously different from vitamins B_1, B_4 and the flavine, has been found also to supplement the growth-promoting power of a pure preparation of lactoflavine, very kindly supplied by Prof R Kuhn Apparently similar results obtained in biological experiments with lactoflavine have already been reported by Chick and Copping[3], and Booher, Blogett and Page[4] Elvehjem and Koehn[5] now report that flavines cannot prevent 'pellagraic' symptoms in chicks, maintained on a ration low in vitamin B_2-content That there is some factor missing in the usual vitamin B_2-deficient diet, that causes cataract in rats, is indicated by the work of Langston and Day[6]. We have ourselves met with cases of cataract among vitamin B_2-deficient rats, but not on an extensive scale

The above would indicate in outline the complexity of what is called 'vitamin B_2' At least four factors appear to be involved—the flavine, the heat-stable factor, the anti-dermatitis factor and the anti-cataract factor, though it is not improbable that two or more of them may be identical We would suggest that provisionally the term 'vitamin B_2' be reserved for the entire complex, which supplements the usual vitamin B_1-deficient diet for the promotion of good growth in rats The other factors may be indicated by their special characteristics or methods of assay—for example, flavine, anti dermatitis factor, anti-cataract factor, etc

We shall, perhaps, know then where we are

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[1] Guha, *Brit Med J* , **2** 53 1931
[2] Guha and Biswas, *Current Science*, **3**, 300 , 1935 *Ber deutsch chem Gesell* , in press
[3] Chick and Copping, *Chemistry and Industry*, **53**, 874 , 1934
[4] Booher, Blodgett and Page, *J Biol Chem* , **107**, 599 , 1934
[5] Elvehjem and Koehn, NATURE, **134**, Dec 29, 1934
[6] Langston and Day, *Southern Med J* **26**, 128 , 1933

Reproduction and Cancer

PROF. E. C DODDS and Dr J W Cook[1] have published much information regarding the chemical and pharmacological relationship between the sex hormones such as œstrin and certain carcinogenic hydrocarbons They have established in those respects an interesting connexion between the growth changes of the uterus and those observed in certain types of cancer

There are other interesting facts concerning the two processes Thus carbon monoxide gas renders mice sterile[2], when breathed in concentrations (0·25 per cent) which do not interfere with the general growth of the body of mice acclimatised gradually ; in the same concentration the gas retards both rate of growth of mouse carcinoma No 63 (Bashford's tumour) and development of tar cancer[3]

Again, embryonic skin of mouse is—equally with placental tissue—the most potent agent in rendering mice immune to transplantable and spontaneous tumours[4], it is possible that this epithelium manufactures 'immune bodies' as the result of œstrogenic and uterine activity The interesting question is why these 'immune bodies' should be most concentrated in the embryonic skin as compared with other embryonic tissues , it may be due to the origin of the skin from ectoderm which in the early stages lies nearest to the uterine decidua, a tissue influenced by œstrin

If œstrin is responsible, directly or indirectly, for production of natural immunity, then we should expect cancer to be most prevalent when the production of œstrin ceases. This is the case, at any rate in the female, since cancer is most prevalent after the menopause

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[1] Ann Rep Brit. Emp Cancer Campaign, 11, 12 , 1934
[2] *Quart J Exp Physiol* , **24**, 271 1934
[3] *J Path Bact* , **35**, 379 , 1932 *ibid* , **36**, 243 , 1933
[4] Murphy, J B , Bull Johns Hopkins Hosp , **56**, 1 , 1935

Raman Spectrum of Gaseous Carbon Disulphide

The $\Delta\nu = 655$ cm.$^{-1}$ Raman band of carbon disulphide was photographed, the substance being in the state of vapour Fig 1 shows a spectrogram taken with a glass *F*/6 two-prism thermostated spectrograph, using a 60 cm vapour column at about 4 5 atm. pressure, irradiated by a mercury arc, the radiation from which was filtered through a dilute solution of potassium chromate to cut off the ultra-violet, avoiding photochemical decomposition and visible fluorescence of the vapour.

The exposure of the spectrogram reproduced was 100 hours on Agfa Isochrom plate, during which the 'Telex' glass Raman tube, air-freed and containing some purified carbon disulphide liquid in its tail annex, was maintained thermostatically at 100° C , the irradiated portion and the sealed-in plane-parallel window at slightly higher temperatures

FIG 1 Raman spectrum of carbon disulphide vapour Copper arc above and below

The satellites found in the spectrum of the liquid[1] and interpreted as due to transitions from excited vibrational states are not resolved, even if present, on our plates, with a linear dispersion 20 A per mm at λ4358 and a large slit width, 0 1 mm According to the most recent and accurate data for the liquid[2] the centre of gravity of the two stronger component bands is shifted by 655 0 cm $^{-1}$ from the exciting frequency

The shift of the intensity maximum in the gaseous spectrum was observed as two Stokes lines of mercury λλ4047 and 4358, and an anti-Stokes line of the latter as marked by an arrow in Fig 1. The measured value from the two Stokes lines on the best plate (reproduced) is 655 ± 1 cm $^{-1}$, and is the same as the liquid shift. The negligible influence of the change of state upon the molecular vibration frequency of carbon disulphide may be expected from the smallness of dipole moment of the substance

The intensity ratio of the $\Delta\nu = 796$ cm $^{-1}$ band to that of $\Delta\nu = 655$ cm $^{-1}$ appears to be much lower in the spectrum of the gas than in that of the liquid. Excepting a very faint and doubtful blackening, no measurable trace of the former band has been recorded above background level up to 125 hours exposure (dotted parts in Fig 1) , whereas with the liquid, as high as 1 · 3 is reported for the above intensity ratio under ordinary conditions of observation[2]. It is intended to measure photometrically the value of it on a denser and sharper plate in the near future

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[1] P Krishnamurti and others See literature in (2)
[2] A Langseth, J U Sørensen and J R Nielsen, *J Chem Phys* , **2**, 402 , 1934

Ring Method for Measuring Surface Tension

A GREAT deal has been written about the ring method since it was rescued from oblivion in 1919. It is to-day more widely used than any other throughout the world. Let us try and analyse the reasons for its success.

The first two reasons are its rapidity and facility. Whoever has laboured over any of the other methods must admit this much. The third reason was the ruggedness of the instrument—a great asset in students' laboratories and lecture rooms. The fourth reason is the reliability of the method. It was primarily intended for biological fluids, and for the first time physiologists and biological chemists could check their measurements without trouble, rapidly. It was its remarkable reliability which induced such workers as Prof. Harkins to devote much of their valuable time to establish the correction formulæ, in collaboration with Dr. Jordan, and to compute the values of the factor F for different dimensions of the ring, so as to make its readings more rigorous. A. Ferguson stated that of twenty odd methods only three were reliable: the ring method was one.

Its accuracy and reliability being established, its rapidity and ease of handling being well known, I still believe that the greatest reason for the success of the ring method was the fact that it proved to be constructive, inasmuch as it disclosed a certain number of new phenomena which were not altogether devoid of interest. I refer to the discovery that, in a solution, the establishment of equilibrium—the only conditions in which the Gibbs-Thomson thermodynamic equation is valid—is a slow process capable of being followed step by step; to the discovery of the factors governing the surface tension of protein and other solutions; of the recovery after lowering of the surface tension of such solutions by surface active substances, due to a mutual adsorption; of the existence of absolute minima; of a method for determining the surface of adsorption of materials such as charcoal, graphite, platinum black, etc.; of a method for following the process of immunity; of a photo-capillary effect in plant sap; of a method for detecting structural changes in serum proteins following inactivation; of a method for detecting alterations in transformer oil after use; of a method for ascertaining the lubricating value of oils, and so on.

Now all these phenomena do not depend on absolute but on relative values. They were found because the method was very rapid, simple, reliable, and because it was possible to take into account the time factor. Relative methods are often more fruitful than absolute ones, as absolute values are of no particular interest except when dealing with pure substances. But I think everybody will agree, particularly the biologists, that solutions offer a broader field of investigation than pure liquids. As a matter of fact, the physical chemist and the physicist use comparatively few absolute methods.

Freud and Freud, however, succeeded in developing a brilliant new theory which led them to accept the ring method as absolute, and this, in addition to the collection of new facts overlooked so far, and difficult, if not impossible, to study with another method, is another important reason why the ring method, in its modern form, has been so widely adopted in research as well as in industrial laboratories.

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Oxidation of Silane

IN view of a reference by Semenoff[1] to some results recently obtained by Schantarowitsch on the upper and lower critical explosion limits in the oxidation of silane, it is of interest to record similar observations which we have made during the last six months.

We have found that pure silane when mixed with oxygen is not explosive at atmospheric pressure, but that when the pressure of the mixture is reduced, ignition occurs at a well-defined limit, which is higher the higher the temperature. The effect of two typical oxidation inhibitors (chloroform and ethyl iodide) has been examined. In small concentrations they lower the upper limit and in larger amounts prevent ignition altogether. This inhibiting action may be counteracted by increasing the temperature. Even a mixture containing the spontaneously inflammable higher hydrides of silicon may be rendered non-inflammable by small amounts of either of these inhibitors, and doubtless other substances will be found to have a similar action.

The lower oxidation limit of silane – oxygen mixtures has been examined in tubes of varying diameter, the walls of which were coated with a film of concentrated sulphuric acid. The following typical results in a cylindrical tube of 1·25 cm. diameter show the order of magnitude of this lower pressure and the relation between the pressure of the separate gases at the limit:

p_{SiH_4} (mm.)	0·837	0·605	0·368	0·272	0·241	0·198
p_{O_2} (mm.)	0·040	0·049	0·067	0·093	0·105	0·159

Under the conditions so far studied, the lower critical oxidation pressure shows a direct proportionality to a power of the vessel diameter slightly greater than unity, and not to the square of the diameter, as in the case worked out theoretically by Semenoff for deactivation on the vessel walls. On dry glass surfaces the lower limit is higher, but consistent results have not yet been obtained.

These results, which will be published in greater detail later, are in general accord with those of Schantarowitsch, as described by Semenoff, and show that the oxidation of silane resembles very closely that of phosphine rather than that of methane.

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[1] "Chemical Kinetics and Chain Reactions", 1935, p. 376.

Reactivity of Carbon

X-RAY examination[1] indicates the presence of graphite in specimens of 'amorphous' carbon. Y. Oshima and Y. Fukuda[2] conclude that coke and charcoal consist of minute particles of graphite contaminated by and cemented together with hydrocarbon complexes. The so-called 'amorphous' forms of carbon generally show a chemical activity much greater than that displayed by graphite. It is, therefore, of interest to report a reaction in which the reverse is the case. During some systematic investigations of the reactivity of various types of cokes it was discovered that graded (60–100 I.M.M. mesh sieves), hard, metallurgical coke is oxidised at 100° by excess of a mixture of chromic and phosphoric acids, much more rapidly than gas and low temperature cokes Further investigation showed that graphite and highly graphitised forms of carbon are oxidised by this mixture approximately 20–25 times more rapidly than sugar charcoal.

The following figures give the weights of carbon dioxide (the amount of carbon monoxide was negligibly small) evolved from 1·0 gm of graded samples in 2½ hours at 100°

Electrode carbon	1,043 mgm
Graphite (natural)	823 ,,
Wood charcoal	328 ,,
Metallurgical cokes	100–200 ,,
Gas cokes	87–135 ,,
Low temperature coke	75–100 ,,
Sugar charcoal	42 ,,

The anomalous position of wood charcoal in the above series is readily accounted for by its porous nature The effect of this can be reduced by fine grinding, and it was found that when more finely powdered specimens were employed the order of the above series remained the same, except in the case of wood charcoal, which fell to the position of sugar charcoal

These results indicate that, when it is possible to eliminate the effect of pore structure by employing a finely graded sample, the above reaction offers a simple method of estimating the amount of graphitised carbon in the various forms of 'amorphous' carbon

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[1] Debye and Scherrer, *Phys Z*, 18, 291, 1917

[2] *J Fac Eng Tokyo Imp Univ*, 18, 125, 1929

Points from Foregoing Letters

IN 1932, Dr Leakey claimed that he had discovered remains of *Homo sapiens* type *in situ* in ancient geological deposits in Kenya The deposits were older than those containing the more primitive types of man elsewhere in the world After a recent visit to the area where the remains were found, Prof P G H Boswell records that the exact sites could not be found, that errors had arisen in connexion with the photographs of the beds and that the deposits in the area had frequently been disturbed by slipping Consequently Prof Boswell regards the geological age of the remains as non-proven.

Prof Kolhorster observed an increase of 1–2 per cent in cosmic ray activity during last December, and he has suggested that it may be connected with the appearance of Nova Herculis Prof W. H. McCrea calculates the energy available when a nova is formed, that is, when (according to Prof Milne) a star collapses from a state of large volume and low temperature to one of small volume and high temperature He concludes that this energy might be sufficient to account for the cosmic rays detected, if the star is entirely gaseous previous to the collapse, as assumed by Eddington's theory, but not if the mass of the star is already concentrated towards the centre

The nuclei of ordinary and heavy hydrogen differ in several physical and chemical properties Drs L and A Farkas calculate the magnetic moment of the proton and deuteron from the rate of chemical reaction of their *para* and *ortho* varieties The value calculated agrees with that obtained by means of the more direct but less accurate method of magnetic deflection

The nuclear field of attraction of the proton extends farther than that of the deuteron, according to Mr. E Pollard and Prof H. Margenau They arrive at this conclusion from the scattering effect produced by the two nuclei upon the α-particles of radium, from which the distance of closest approach may be calculated.

The range of velocity in the electrons (β-rays) emitted by chlorine, bromine and iodine, after neutron bombardment, has been determined by Messrs. A I. Alichanow, A. I Alichanian and B S. Dželepow From mass-energy considerations, the authors are led to expect that hard γ-rays are also emitted during the nuclear reactions involved

Experiments on the reflection of radio 'pulses', made by Messrs J P Schafer and W. M. Goodall during the solar eclipse of February 3, showed a decrease in the electrical conductivity of various layers or regions of the upper atmosphere The results, though not conclusive, support the view that ultra-violet light is an important factor in producing ionisation in those regions.

E Brandenberg, in Holland, has found that the crown rot of sugar beet is due to boron deficiency, and not to a fungus disease Mr W Hughes and Prof P. A Murphy submit further experimental proof and state that the addition of 12–20 lb of borax per acre improves considerably the yield of beet in areas affected by crown rot

Dr B C Guha suggests that the term vitamin B_2 be used for the whole complex found by biological assay to be necessary to promote good growth in rats grown upon a special diet He advocates that the specific terms, anti-dermatitis factor, anti-cataract factor, etc., be used when special tests are applied involving the appearance of those diseases.

Experiments with the sex hormone (œstrin) have led to the opinion that its presence in certain circumstances may produce cancerous tissue Mr J Argyll Campbell brings forward observations suggesting that under normal conditions œstrin may be responsible for providing immunity from cancer

Dr. H J Emeléus and Mr K Stewart find that chloroform and ethyl iodide inhibit the ignition of a mixture of silane (SiH_4) and oxygen. The authors have determined the pressure at which silane becomes oxidised and find it approximately directly proportional to the diameter of the vessel used; they state that in general the oxidisation of silane resembles that of phosphine rather than that of methane.

Many instances are known in which charcoal appears to be chemically more reactive than graphite, especially when absorption is involved. Prof H L Riley and Mr. H E Blayden now find that graphite oxidises 20–25 times more rapidly with a chromic-phosphoric acid mixture, at 100°, than sugar charcoal. The reaction offers a means of estimating the amount of graphite in 'amorphous' carbon.

Research Items

Serbian Gypsies. In the course of studying the life of Serbian peasants, Mr. Alexander Petrović has collected data relating to the Serbian gypsies, and has published the first of a series of observations (*J. Gypsylore Soc.*, 3, **14**, pt. 1), in which he deals with practices relating to theft. The gypsies recognise two forms of stealing, of which the first is from a Serb, when all keep silence, and the second from another gypsy, which is considered most disgraceful, and is followed by a vociferous lamentation on the part of the injured party, similar to the lamentation over the dead. It is only considered a sin to steal when what is taken is already in the house and is not needed. The gypsies perform spells for successful theft. On Christmas Eve, straw is obtained from the peasants and three twigs—of oak, beech and ash—are placed under the eaves of the house. At dusk, straw is scattered on the floor of the house and food, nuts, etc.—everything there is in the house except food containing animal fat—is placed on the table. Before supper, nuts are thrown in the four corners of the room. After the supper the housewife perambulates the house thrice, followed by the children, imitating the cries of hen and chickens. At dark all disperse to steal something in the neighbourhood, usually of no value, such as twigs or branches. Whatever is stolen is brought back and thrown in the fire, with the saying, "May it never be known what I have been stealing to-night", and then as it burns, "As this fire burns brightly, so may I steal quickly and cleverly". If a gypsy is caught in his theft, he is made fun of and not allowed to steal in the coming year.

Artificial Incubation of Pheasant Eggs. Heat and moisture are important factors in the development of birds' eggs, and the development of artificial incubation of game birds' eggs, especially in the United States, has suggested that an analysis of these factors may be of great service in reducing uncertainty in hatching and inferior quality of stock due to improper handling during incubation. The most efficient temperature for the incubation of pheasant eggs, when other physical conditions were kept constant, was 102° F. for the first period (to the end of the seventh day), 101° F. for the second period (days, 8–16), and 100° F. for the third period (up to hatching on 24th day). During the third period the incubation temperature may be considerably lowered with benefit to the embryo. As regards humidity, pheasant eggs require higher at the beginning and lower at the end of incubation, a gradient from about 75 per cent relative humidity down to about 65 per cent (Alexis L. Romanoff, Bull. 616, Cornell Univ. Agr. Exp. Stn., Ithaca, Nov. 1934). It is to be noted that temperature and moisture demands are specific, so that the needs of the quail (*Colinus virginianus*) fluctuate within a much closer range of temperature (101° F. throughout), and require a somewhat lower humidity at the beginning and higher at the end of incubation (rising from about 65–75 per cent relative humidity). The treatment of eggs of various game-birds in the same incubator is likely therefore to lead to poor results.

Australian Acarina or Mites. Mr. H. Womersley has recently published a revision of the mites belonging to the families Erythræidæ and Trombidiidæ in Australia (*Rec. South Australian Mus.*, **5**, No. 2). Species of the first-mentioned family are parasites of the early stages of insects, while the Trombidiidæ are well known to be of economic importance since their larvæ are irritating pests of man. Apart from larval forms, 32 species and 2 varieties of Trombidiidæ were previously known from Australia, and 9 species of Erythræidæ. Comparatively little work has been done on this section of the fauna, only four workers having written on the subject previously. In the present paper, 46 species and 4 varieties of Trombidiidæ are listed, of which 2 genera, 14 species and one variety are new, together with two new species only known as larvæ. Of the Erythræidæ, 24 species of adults are listed, of which one genera and 14 species are new. Nine new species of larval forms of this family are described and, it may be added, no larvæ have been previously recorded from Australia. The paper is accompanied by numerous illustrations of a diagnostic character, together with a bibliography.

Ganglion Cells in the Hearts of Invertebrates. Three papers have been published by Senji Suzuki on this subject: "On the Ganglion Cells of the Heart of the Pearl Oyster *Pinctada martensi* Dunker", "On the Innervation of the Heart of Limpets" and "Ganglion Cells in the Heart of *Ligia exotica* (Roux)" (*Sci. Rep. Tôhoku Imp. Univ.*, Fourth Series (Biology) Sendai, **4**, Nos. 2 and 3, 1934). Ganglion cells were found in the heart of all these animals. In the pearl oyster the heart is not traversed by the rectum, the muscles being better developed in the ventricle than in the auricle. It was found that ganglion cells were more numerous in the auricle, especially just before its junction with the ventricle. The limpets *Cellena nigrolineata* and *C. eucosmia* were alike in having the heart supplied by a nerve from the visceral ganglion and having several ganglion cells in the heart of large size and easily stainable, there being more in the ventricle than in the auricle. In the isopod *Ligia exotica*, there is a nerve fibre bundle with six ganglion cells along the dorso-median line of the heart.

Moulting and Metamorphosis in *Rhodnius*. Dr. V. B. Wigglesworth (*Quart. J. Micro. Sci.*, **77**, Pt. 2, Dec. 1934) shows that in the blood sucking bug *Rhodnius prolixus* the number of moults is absolutely fixed; no departure from the normal five nymphal stages has been observed among hundreds of these insects reared in the laboratory. The five nymphal stages are more or less alike; the adult differs markedly from the nymphs. There are thus two phenomena to be considered—simple moulting and moulting coupled with metamorphosis. Moulting occurs at a definite interval after feeding, only one meal being necessary in each case. There is a 'critical period' in the moulting cycle, about 7 days after feeding in the fifth nymph, about 4 days in the earlier nymphs, and removal of the head before this period prevents moulting. Insects sharing the same blood moult simultaneously, hence the process of growth must be co-ordinated by chemical factors presumably produced by the growing cells. If fourth or even first nymphs of *Rhodnius*, decapitated soon after feeding, receive blood from moulting fifth nymphs they undergo a precocious metamorphosis and develop adult characters. Metamorphosis is therefore brought about by chemical differences in the blood. If fifth nymphs, decapitated soon after feeding, receive blood from moulting fourth nymphs, they also moult, showing that the moulting factor is the same at all stages. The absence of metamorphosis in normal nymphs before the fifth stage must therefore be due to some inhibitory factor or hormone in the blood. The head is necessary for the secretion of this inhibitory hormone.

Cytology of Variation in Apomictic Genera. Various theories have been put forward to explain the origin of polymorphic groups of species in genera with apomictic reproduction, such as *Taraxacum*, *Hieracium* and *Antennaria*. It has been supposed that they are partly sexual and have thus given rise to a swarm of forms through crossing, and it has been assumed that, even with apomictic development, gene mutations might occur which would give rise to new biotypes. In a cytological study of these conditions in *Taraxacum*, Dr. A. Gustafsson (*Hereditas*, **19**, 259) concludes that partial fertility does not occur in these dandelions and that new biotypes cannot be formed by the above methods. He finds, however, in the megaspore mother cell, what is described as a pseudohomotypic mitosis occasionally occurring, in which the chromosomes of the heterotypic metaphase do not pair but arrange themselves in a single plane and divide. It may happen that both daughter halves of a particular chromosome pass to the same pole. The normal pairing of chromosomes may also lead to crossing-over. In both of these ways it is possible that new biotypes ('pseudomutations') may arise in forms which are totally apomictic. The fact that in *Antennaria alpina* males arise from females although the latter are totally parthenogenetic and show various grades of intersexuality, is explained by the hypothesis that the *X* and *Y* chromosomes undergo crossing-over in prophase and may also undergo irregular distributions in the pseudohomotypic division.

Fungi in the Air over Orchards. When apples are gathered late in the season in several districts, they fall a prey to numerous fungi which cause unsightly 'spots' to appear during storage. Horne and Nitimargi have shown that the air above an orchard contains the spores of many fungi which produce such disfiguration, whilst Mr. F. M. Carter, of the Imperial College of Science and Technology, has recently published the results of a continuation of this work (*Trans. Brit. Mycol. Soc.*, **19**, No. 2, 145–153, Jan. 1935). Plates of nutrient media were exposed in orchards at East Malling, Swanley and Belfast, and the fungi which appeared were cultured and identified. An extensive list of species is given, and it is rather significant that most of them are known to occur in apple 'spots'. The majority of organisms isolated from diseased apple tissue are also represented in the list. Some species, such as *Sporotrichum roseum* and *Verticillium lateritium*, have not previously been obtained from diseased apples, but are shown by the present account to produce rotting when inoculated artificially. Particular attention has been paid to *Pleospora herbarum*, and several new forms of the genus *Polyopeus* have been noted.

A Pliocene Flora from Shansi Province. In the *Bulletin of the Geological Society of China* (**12**, No. 2; 1933) R. W. Chaney describes a flora comprising eight species from lake deposits near Taiku, Shansi Province, which have been referred to the upper Pliocene on the basis of stratigraphical relations and faunal evidence. The modern equivalents of the Taiku flora are found for the most part in the cool, semi-arid provinces of northern China, and a climate of this type appears to have characterised this part of China during the late Pliocene. All the fossil species are described as new, but they show a general resemblance to the Pliocene flora of western North America. The more humid and somewhat warmer type of climate indicated by the middle Tertiary floras of north-eastern Asia suggests that there has been a progressive trend towards cooling and aridity in this region since the Oligocene, which corresponds to similar climatic changes already noted in western North America during the Tertiary.

Nevada Earthquake of December 20, 1932. The Cedar Mountain (Nevada) earthquake, which ranks as one of the strongest of recent earthquakes in the United States, is described in a valuable paper by Messrs. V. P. Gianella and E. Callaghan (*Amer. Seis. Soc. Bull.*, **24**, 345–377, 1934). Though it caused but little damage and no loss of life—the central area is thinly populated—the shock was definitely felt over an area of 400,000 square miles. The principal shock occurred at 10.10 p.m., Pac. St. Time, and its epicentre lay in lat. 38° 7′ N., long. 117° 8′ W. One fore-shock was felt at 9.32 p.m. and thousands of after-shocks occurred within the next year with their epicentres lying along a belt nearly 100 miles long from north to south. The most interesting feature of the earthquake was the formation of about sixty rifts in the epicentral area. These rifts differ from the secondary fissures formed in alluvium with every great earthquake, for they were caused by actual shifts of adjoining rock-masses and can be traced across ridges of rock. They vary in length from a few hundred feet to about four miles, and in width from less than an inch to 400 feet. They occupy a belt about 38 miles long from north-west to south-east and 4–9 miles wide, and occur in a general echelon pattern. With one possible exception, all are essentially vertical, and nearly all the larger rifts show a vertical displacement, usually down the slope. In a few rifts, positive evidence of horizontal movement was detected, in one place amounting to 34 inches. In all of them, the east side was shifted relatively to the south, and this is also indicated by the echelon pattern of the rifts. The authors notice the agreement of this direction with that during the Owen's Valley earthquake of 1872 and the Californian earthquake of 1906.

Ultra-Violet Glasses. The December 1934 issue of the *Journal of Research* of the National Bureau of Standards contains a research paper on ultra-violet transmission changes in glass as a function of the wave-length of the transmission stimulus, by Drs. W. W. Coblentz and R. Stair of the Bureau. It constitutes an important addition to the series of papers which have issued from the Bureau dealing with the properties of these glasses. The object of these investigations is to determine what are the particular wave-lengths in sunlight which cause deterioration of the transmission of such glasses, for what wave-lengths this deterioration is most marked and what is the constituent of the glass which is accountable for the changes. So far, it seems the deterioration is due mainly to wave-lengths shorter than 3000×10^{-8} cm. and the greatest reduction in transparency is for wave-lengths of this type. For 3050 the reduction is to about 40 per cent of the initial transparency after six weeks exposure to sunlight in May and June, and it remains near that figure for a considerable period. By exposing the glass to light between λ 3300 and λ 4050, the transparency for λ 3000 light may be increased about 10 per cent. As this rejuvenating light is present in sunlight, both deterioration and improvement of transparency are going on during daily exposure. The overall deterioration for the whole of sunlight is to about 80–85 per cent of the transmission of freshly made glass. In soda lime glasses the soda appears to be the sensitive constituent.

Surface and Interfacial Tension of Mercury. Recent values for the surface tension of mercury range from 400 to 500 dynes/cm., and those for the interfacial tension between mercury and water from 370 to 427 dynes/cm., the greatest disagreement existing in the values found by the sessile drop method. H. Brown (*J. Amer. Chem. Soc.*, 56, 2564; 1934) has modified this method and finds that the results obtained with large flat drops and with small ones agree with those obtained with the drop weight method. The interfacial tension against water was found to be 374·3 dynes/cm. at 25°, and the surface tensions in dry air and in a vacuum are the same to within 0·3 per cent, namely, 473 at 25°. Thermodynamic considerations show that the surface tension of mercury in a vacuum must be at least 447 at 25°, which excludes some previous values. On the assumption that a mercury surface oxidises in air only in the presence of water vapour, some puzzling results can be explained, such as irreversible adsorption effects and the different results sometimes obtained with a static and a dynamic method. The fact, first observed by Quincke, that water spreads on a fresh clean mercury surface, affords an excellent criterion of the cleanliness of a mercury surface.

Emission Spectra of Alkali Halides. H. Hamada has recently discussed the emission spectra of the vapours of the chlorides, bromides and iodides of sodium and potassium (*Phil. Mag.*, Dec. 1934). The spectra were obtained by heating the salts in the hollow cathode of a discharge tube. With sodium salts, the *D* lines are intensely excited and there is a nearly continuous spectrum extending to the long wave side of these lines. Near the lines some band structure is observed. There is a faint apparently continuous spectrum on the short wave side of the *D* lines. Similar results are obtained with the potassium salts. The results are correlated with the Franck-Condon theory of molecular excitation. Most of the molecules excited by electron impact go into an unstable state which dissociates into a normal halogen atom and an excited sodium atom. The latter atoms emit the *D* lines. In an alternative process, however, the electronically excited molecule may be set in vibration without dissociating, and it then gives rise to the band spectrum observed.

Down-coming Radio Waves. D. F. Martyn and A. L. Green (*Proc. Roy. Soc.*, A, Jan.) have studied the wireless waves reflected from the upper atmosphere, using a receiving system containing a vertical wire aerial and two vertical loops at right angles. Each of these aerials was connected to a separate receiver and recording galvanometer. The results obtained show that the down-coming, elliptically polarised ray is often deviated laterally out of the plane of propagation. This phenomenon is probably responsible for the inconsistent results obtained by other methods in measuring the angle of incidence of down-coming waves. The present method enables the authors to calculate the position of the ionospheric reflecting centres responsible for the down-coming ray; these centres move about rather rapidly. The angles of incidence observed correspond approximately to symmetrical reflection in the ionosphere, and the polarisation of the down-coming wave is normally, but not always, approximately circular.

Pure Calcium Chromate. When calcium chromate is prepared by mixing solutions of calcium chloride and potassium chromate, the precipitated calcium chromate is always contaminated with adsorbed potassium and chloride ions. Prof. J. Milbauer and Dr. J. Doškař have now discovered a method which overcomes this difficulty and have published their results in the *Proceedings of the Masaryk Academy of Work* at Prague. These authors have worked out the exact conditions for the precipitation of calcium chromate by mixing solutions of calcium chloride and sodium chromate. The best results were obtained by adding a solution containing 400–450 gm. of calcium chloride per litre to a saturated solution of sodium chromate so that the former was in excess, namely, 1·6 times the amount required according to the equation

$$Na_2CrO_4 + CaCl_2 = 2\,NaCl + CaCrO_4$$

The best temperature for the reaction was between the limits 18° and 27° C. The precipitate of calcium chromate so obtained was readily freed from any adhering salt or excess of calcium chloride, and is said to be particularly pure.

Fatigue Research and Engine Design. The failure of revolving shafts in engines and machinery has occurred so frequently that it has led to much investigation. Ships have been lost through the breakage of propeller shafts and many motorists have been delayed by the fracture of rear axles. In a booklet published by the Society of Motor Manufacturers and Traders in 1932, it was stated that, of all the breakdowns in motor-vehicles, the breaking of rear-axle shafts accounted for 13·6 per cent. In most cases such failures result in nothing but expense and delay, but when shafts in ships break, the consequences may be disastrous. Ever since the screw propeller was adopted, shafts have broken; anything that can explain the causes is of value to the designer. A good deal of light is thrown upon the subject in a paper read on January 25 to the North East Coast Institution of Engineers and Shipbuilders entitled "The Relation of Fatigue to Modern Engine Design". In this paper, Mr. R. A. Macgregor treated it from the aspect of the manufacturer of steel forgings, Mr. W. S. Burn dealt with it as an engine designer while Prof. F. Bacon referred to some results of researches in the laboratory. In Mr. Burn's view, researches on fatigue endurance by scientific engineers were "sufficient to prove that it can be rendered quite a harmless germ if the correct antidote is administered. The antidote is simply the avoidance of stress concentration or notch effect". He gave some interesting examples of the improvements effected in engine parts by the application of this maxim. The paper contains a bibliography of more than two hundred books and papers published on the subject of fatigue in this and other countries.

Measurement of Geological Time*

THE report of the Committee on the Measurement of Geologic Time for the year ending April 28, 1934, prepared by the chairman, Prof A C Lane, contains an imposing record of the progress achieved and gives some account of the varied and far-reaching character of the researches now being carried out Prof Lane contributes an article dealing with the history of the subject He also directs attention to his proposal that the isotopes of uranium from which the various series originate should be distinguished as Ur-radium, Ur-actinium, Ur thorium and (if needed) Ur-virginium

The more important of the new age determinations are listed in the accompanying table All are calculated from lead ratios except those for the Triassic and Keweenawan basalts, which are based on helium determinations. As helium is liable to escape, the highest figure for the Keweenawan is most likely to be correct. From the radium contents of the travertine deposits of the Mammoth Hot Springs, Yellowstone Park, H Schlundt finds various ages up to 14,000 years A purely geological method is applied by F J Pack to the measurement of post-Miocene time. He has determined the rate of recession of the wall of Bryce Canyon at two feet per century. The wall has receded a hundred miles since the Miocene, corresponding to a period of the order 26 million years This corresponds well with the age of 28 million years found for the Cleveland Dyke in Co Durham

Geological Age	Material and Locality	Investigators	Age in Millions of Years
Triassic	Basalt, New Haven	W D Urry	170
Permian	Pitchblende, Wölsendorf	F Hecht and Edith Kroupa	205
Permian	Thorite, Langesundfjord	A von Grosse	226
Devonian	Uraninite, Glastonbury	C N Fenner	296
Late Ordovician	Uraninite, Fitchburg	F Hecht and Edith Kroupa	336
Late Cambrian	Kolm, Sweden	W R Bennett	444
Keweenawan	Basalt, Calumet and Hecla	W D Urry	302 610
Pre-Witwatersrand	Uraninite, Gordonia	A Holmes and F Hecht	925
Laurentian	Uraninite, Quebec	H V Ellsworth	1040
Pre-Laurentian	Pitchblende, Great Bear Lake	J P Marble	1260
Pre Laurentian	Monazite, Manitoba	Edith Kroupa	1725

New methods for the determination of radium have been devised by R D Evans and for thorium by W D Urry Work on the actinium series has been carried out by A von Grosse and A E Ruark A F Kovarik has found that the half-period of thorium is close to 1 3 × 10^{10} years, a result that agrees with independent measurements by Heimann and by Fesefeldt and confirms the value adopted by Kovarik and Holmes in the "Age of the Earth" (*Bull* 80, Nat Res Coun , 1931) Determinations of the atomic weight of lead from radioactive minerals have been made by O Honigschmid, J P Marble, C M Alter and A D Bliss

The extremely sensitive magneto-optic methods of F Allison have now been brought into use C S Piggot, of the Geophysical Laboratory, has co operated with Allison in detecting the isotopes of lead in various minerals, particularly those of the Great Bear Lake pitchblende deposits Sixteen isotopes of lead are now known and eight of uranium The programme of research on the disintegration of potassium and the accumulation of Ca^{41} in rocks and minerals during geological time, announced by Holmes at the York meeting of the British Association, is being carried out systematically in collaboration with Allison, who has so far determined Ca^{41} in about a hundred analysed materials The results, which it is hoped will soon be published, not only throw much-needed light on the vexed question of the origin of igneous rocks, but also serve in the case of appropriate rocks and minerals to determine the period at which consolidation took place

Prof Lane and his Committee and the active team of associated workers are to be congratulated on the spectacular acceleration of progress that the last few years have witnessed

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* National Research Council Division of Geology and Geography Report of the Committee on the Measurement of Geologic Time, presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, April 28, 1934 Pp ii+86 (Washington, D C National Research Council, 1934)

The Pre-Crag People of Suffolk

ON February 19, Mr Reid Moir spoke at the Royal Anthropological Institute on "The Age of the Sub Crag Flint Implements". It is now twenty-five years since the first traces of man were found in the Suffolk Bone Bed beneath the Red Crag The Bone Bed is of very considerable geological antiquity, and predates those deposits containing the earliest palæolithic implements.

Mr. Reid Moir has carried out many excavations in the Suffolk Bone Bed, and after a very searching examination of a large number of artefacts from this deposit, concludes that these can be divided into five groups which show marked differences from each other These differences make themselves manifest in colour and condition, and in the types and flaking of the various specimens The characteristics mentioned serve to differentiate the groups, which moreover contain artefacts which exhibit reflaking. Such specimens, which are well known in later prehistoric cultures, represent those which were flaked by one man, and then patinated and stained, to be found afterwards and reflaked by another and later man. The later flaking shows usually a different colour from the earlier, and clearly cuts through the more ancient surface Further, the colour of the more recent flaking can be matched with that of another group, and so on, thus establishing the fact that below the Red Crag there exist five periods of human flaking upon the flints there assembled. Mr Reid Moir has carried out an exhaustive series of measurements of the specimens in each group and this supports the conclusions based upon colour and condition, as to the reality of the presence of the five groups mentioned.

The Suffolk Bone Bed is a typical residual deposit made up largely of the wreckage of strata at one time existing in East Anglia, and broken up by the irruption of the sea into the area in Crag times. At Bawdsey, on the Suffolk coast, the sea is to-day attacking a cliff composed of London clay, Red Crag, Glacial Gravel and surface material. As these various beds are washed away, the heavier contents collect at low tide mark, and are forming a deposit similar in some respects to the Suffolk Bone Bed. It is indeed highly probable that this was accumulated under analogous conditions, and it is possible that the mammalian remains of different ages in the Bone Bed, together with the flint implements, at one time occupied their respective geological horizons in the now vanished land of Suffolk.

The mammalian bones and teeth in the Suffolk Bone Bed range from Upper Miocene to late Pliocene times, when this deposit was laid down. It is possible that the earliest group of the sub-crag flint implements may date back to the earlier part of the Pliocene, or even to more ancient times, but this is not yet established. The specimens of the earliest group, though exhibiting many archaic characteristics, cannot however be looked upon as the type of artefact likely to be made by the earliest representatives of the human race; but this group is obviously of an extreme antiquity, and its existence points to a much greater age for the human race than has hitherto been supposed. It has long been recognised and accepted that man was present in East Anglia before the deposition of the Red Crag some 500,000 years ago, but it now appears that this period of time must be greatly extended to include the earliest group of the pre-Crag artefacts.

The excavations which over a number of years have been conducted by Mr. Reid Moir in the Suffolk Bone Bed, have been made possible by the invaluable financial help of the Royal Society, the Percy Sladen Memorial Fund and Mr. T. R. Parkington of Ipswich.

Artificial Production of the Hormone of the Corpus Luteum

THE transformations of cholesterol into the male sex hormone (androsterone) and of stigmasterol into a crude product having the biological activity of the corpus luteum hormone[1] have been rapidly followed by further important developments in this field of investigation of the sex hormones, and the corpus luteum hormone has now been prepared in a chemically pure state from stigmasterol and also from pregnandiol.

The conversion of pregnandiol into the hormone was achieved by Butenandt and Schmidt[2] in a strikingly simple manner. Having first shown that by partial hydrolysis of pregnandiol diacetate the nuclear acetoxy group was hydrolysed, they converted the monoacetate by a series of stages into the hormone, and showed thereby that the hormone was the $\Delta^{1,2}$ or $\Delta^{4,5}$ unsaturated diketone corresponding with pregnandiol. These authors then found that pregnandiol could be transformed into the pure hormone by three simple stages, namely, oxidation to pregnandione, monobromination, and subsequent elimination of hydrogen bromide by heating with pyridine. As pregnandiol may be isolated from the urine of pregnancy without difficulty, there is no doubt that considerable supplies of the artificial hormone will be manufactured by this method.

The isolation of the pure hormone from the degradation products of stigmasterol has been recorded by Fernholz[3] and by Butenandt and Westphal[4]. As Fernholz and Chakravorty[5] have also shown that both cholesterol and stigmasterol may be degraded to the same 3-hydroxy-*nor-allo*cholanic acid, this conversion of stigmasterol into the corpus luteum hormone establishes the positions 3 and 20 for the two keto groups of the hormone. The $\Delta^{4,5}$ position of the double bond is also regarded by Butenandt and Westphal as established by the formation of the hormone from stigmasterol, but since the position of the double bond of stigmasterol is based only on analogy with cholesterol[6] it is better to admit that the $\Delta^{1,2}$ position for the double bond of the hormone has not been rigorously excluded.

Butenandt and Mamoli[7] have directed attention to the fact that pregnandiol is therefore a hydrogenation product of the hormone, and in the light of this conception it is easy to understand the presence of large quantities of pregnandiol in the urine during pregnancy, for the diol is thus seen to be the form in which the hormone is excreted, just as cholesterol is excreted in the form of its hydrogenation product, coprosterol.

The artificial hormone, like that prepared from corpus luteum extracts, exists in two polymorphous forms, one of which is readily converted into the other[8].

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[1] NATURE, **134**, 758; 1934.
[2] *Ber.*, **67**, 1893, 1901; 1934.
[3] *ibid.*, p. 1855, 2027; 1934.
[4] *ibid.*, p. 2085.
[5] *ibid.*, p. 2021.
[6] Fernholz, *Annalen*, **507**, 128; 1933.
[7] *Ber.*, **67**, 1899; 1934.
[8] See Butenandt and Schmidt, *Ber.*, **67**, 2088; 1934.

Temperatures of the Stars

IN a lecture before the Newcastle-on-Tyne Astronomical Society on December 12, Mr. W. M. H. Greaves described the way in which stellar temperatures are derived from a study of the spectra of stars.

All information regarding temperatures of the stars is derived from their light and its analysis. In heating a metal, while at first the radiation is almost entirely limited to the infra-red, with increase of temperature it includes wave-lengths in the visible part of the spectrum, and the proportion of blue to red light emitted increases as the temperature rises. But we cannot generally find temperature from colour, since the emissivity of bodies varies. Nevertheless, our knowledge of the temperature of stars is derived from measures of the colour of star light, the source of which is the outer layers of the star.

The 'black body', which theoretically absorbs all radiation falling on it and which, when heated, emits radiation of all kinds, is taken as a standard of reference. For such a body the proportions of emitted light at different wave-lengths are connected with temperature by Planck's formulæ. Observation shows that, so far as measurement made between spectral lines is concerned, stars are emitting radiation in a similar manner to black bodies, although they are actually 'grey body' radiators. This being so, the continuous spectrum of a star can be matched in colour with black body radiation corresponding to some temperature, and this temperature is called the 'colour temperature' of the star.

The light from a star consists of radiation from its surface and, to some extent, radiation from its lower layers which has only been partly absorbed on its way to the surface. Theoretical investigation shows that, subject to certain hypotheses, the colour temperature of a star is about twenty five per cent greater than the actual temperature of the surface. A comparison is made between the light emitted by the star and a laboratory source the colour temperature of which is known, and it is necessary to measure the ratios of the radiations from the star and the laboratory source at two separate wave-lengths. Applying Planck's formula for the ratio of the radiations from the latter at the two wave-lengths, the measured ratios make it possible to derive the ratio of the radiations from the star at these wave-lengths. We then have the data to give the colour temperature.

For measurement, the spectra from the star and laboratory source are photographed on the same plate and the photo-chemical properties of the emulsion are utilised, since there is a relationship between the optical density or degree of blackening of the negative and the amount of light which caused it. By an additional series of exposures of the plate to sources of light the relative intensities of which are known, spectral images are formed which enable a calibration curve to be made for any particular wave-length, and from this, differences in optical density can be converted into ratios of light. The data obtained yield a quantity known as the 'colour function', which is related to colour temperature by a formula derived from Planck's formula, and thence the colour temperature of the star is obtained.

Star light is reddened in passing through the earth's atmosphere and the observations have to be corrected for this effect. Use is made of a system of stars the differences of colour function of which have been measured by a set of comparisons in pairs at equal altitudes above the horizon. Pairs of stars chosen from this system are now photographed at unequal altitudes, and each such comparison yields a quantity, part of which is due to difference in colour function and part to the atmospheric effect. As the difference of colour functions has been already obtained, atmospheric reddening can be determined and applied to comparisons between stars and the laboratory source used for comparison.

Well-determined colour temperatures for a number of stars are now available as a result of the work at different observatories, and in the study of the relationship between temperature and other effects a striking correlation of temperature with spectral type has been found.

Reorganisation of the University of Durham

THE University of Durham entered upon the second century of its existence three years ago with prospects somewhat clouded by controversies relating to medical education. The Royal Commission appointed in March 1934 to report on the University's organisation and work found the constitution of the College of Medicine, which, together with Armstrong College, forms the Newcastle Division of the University, and also the University statutes, to be radically unsound in many respects and more particularly in their failure to confer on the University any control over the fate of one of its own professors.

The recommendations of the Commission, embodied in the report just published (London: H.M. Stationery Office, Cmd. 4815. 1s. 6d. net) provide for the reconstitution of the Newcastle Division as a single unit by the amalgamation of its two colleges under a head, to be appointed, in the first instance, by the Crown. For the guidance of the organisation and development of medical education and the maintenance of close relations between the College and the associated hospitals, responsibility would be vested in a dean of medicine, to be *ex-officio* a member of the Court and Senate of the University and of the Council and Academic Board of the College and chairman of the Board of the Faculty of Medicine and of the Medical Studies Committee of the Academic Board.

Of the two schools of thought with regard to the place and treatment of chemistry and biology regarded as part of the medical curriculum proper, the Commission has ranged itself emphatically on the side of the champions of the closest collaboration between the medical departments and the science departments in a university, the precise allocation of the teaching of the various frontier subjects being left to be determined in the light of the whole of the teaching power which is available, rather than by mere departmental considerations: granted the desirability of relating the teaching of chemistry and biology to human physiology and anatomy and to medical problems generally, the one thing to avoid, in the interests of the teachers themselves as well as of the students, is a divorce of this specialised teaching from the university departments devoted to chemistry and biology.

Medical education in Newcastle has been somewhat hampered for many years by inadequate premises. Land for new buildings adjoining Armstrong College and opposite the Royal Victoria Infirmary has been acquired, however, and an extensive scheme involving the sale of the present site of the College of Medicine has for some time been under consideration. Among the recommendations of the Royal Commission on the affairs of the University is one for the constitution of a temporary board of five persons, four appointed by the College of Medicine and one appointed by Armstrong College, to sell the existing premises and generally to arrange for the finance of the new building, to control the proceeds of sale and the greater part of the capital funds at present vested in the College, to assume control of the new site and supervise the erection of the new buildings and ultimately to transfer the premises together with any funds in its hands to the proposed new University College to be formed by amalgamation of Armstrong College with the College of Medicine. A time limit not exceeding seven years would be fixed within which the Board would have to complete its activities.

The Durham Observatory, which was opened in 1841, is at present vested in the Council of the Durham Colleges, and is managed by a large body of curators, of whom some are teachers in Newcastle.

In the general debacle which overtook the teaching of science in the University of Durham in the eighteen-sixties, the study of astronomy survived and at times the astronomical work has been of considerable importance. A seismograph was installed in 1929. Among the Royal Commission's recommendations for the future government of the University is a proposal that the Observatory should be transferred from the Council of the Durham Colleges to the University. It is pointed out that, there being science departments in both the Durham and the Newcastle Divisions, the work of the Observatory should be regarded as a central university activity.

University and Educational Intelligence

CAMBRIDGE.—The General Board has issued a report on the future organisation of teaching and research in crystallography. The following recommendations are made. (1) The Crystallographic Laboratory shall be under the control of the Cavendish professor of experimental physics. (2) All teaching of crystallography for Part I of the Natural Sciences Tripos shall be given in the Department of Mineralogy and Petrology. All teaching of crystallography for Part II of the Natural Sciences Tripos shall be given in the Crystallographic Laboratory. (3) The research facilities of the Crystallographic Laboratory shall be available for use by the staff of the Department of Mineralogy and Petrology and the research facilities of the Department of Mineralogy and Petrology shall be available in a similar manner for use by the staff of the Crystallographic Laboratory. (4) There shall be an assistant director of research in crystallography who shall be responsible to the Cavendish professor for advanced teaching and direction of research in crystallography. (5) There shall be an assistant in experimental research in crystallography whose duty shall be to help the assistant director of research. He shall be appointed by the Cavendish professor, subject to confirmation by the General Board. It is recommended further that Mr J. D. Bernal, of Emmanuel College, be appointed assistant director of research in crystallography from October 1, 1934, with a pensionable stipend of £500 a year.

OXFORD.—The contributions to science by the early members of Wadham College formed the subject of a public lecture in the Hall of the College on March 2. The speaker, Dr R. T. Gunther, stated that but for a most lamentable accident the lecture would have been delivered by the late Dr F. A. Dixey, whose unrivalled knowledge of the connexion of the early fellows of the College with the foundation of the Royal Society had delighted many audiences in that hall. Portraits of John Wilkins, Sprat, Seth Ward and Wren hang on its walls. Sydenham and Mayow were among its members. Less well-known was the botanical work of Walter Stonehouse (1597–1655) and of Richard Warner (1713–75).

THE Royal University of Pisa is offering a research scholarship for the year 1935–36 under the Galileo Galilei Foundation. The scholarship is open to all and, if a candidate is not Italian, he will be expected to carry out scientific research in an Italian institute during the tenure of the scholarship. Further information can be obtained from the Rector of the University of Pisa.

THE first Regional British Isles Conference of the New Education Fellowship will be held at the University of St. Andrews on August 13–22, under the presidency of Dr. A. D. Lindsay, Master of Balliol College, Oxford. The theme of the Conference will be "Education and Leisure: How to Create a Democratic Culture". Two problems will be discussed, namely, education for leisure at schools and the provision of facilities and training for adolescents and adults so that they may be able to make use of their leisure after school life is over. The subject of Dr. Lindsay's address will be "Unemployment and Education". Further information can be obtained from the New Education Fellowship, 29 Tavistock Square, London, W.C.1.

Science News a Century Ago

A Description of Upper California

At a meeting of the Royal Geographical Society on March 9, 1835, a communication was read from Dr. Coulter describing Upper California, in which he had resided for two years. The only portion of the country which was settled was mainly along the coast, the chief settlers being the Catholic missionaries, who sought to collect around their stations an Indian population, whom they taught, in a rude way, to till the ground and rear domestic cattle, while they compelled them to conform to their religious observances. The great article of produce was black cattle. In 1827 the missions possessed 210,000 branded cattle, and it was supposed not less than 300,000 unbranded. The number of white inhabitants in Upper California was estimated by Dr. Coulter at 6,000, and they were rapidly increasing, while the Indian population was decreasing. The prospects for settlers in the north were good, the district being highly fertile, well wooded and watered. The Tuli Lakes, although shallow in the dry season, furnished good facilities for the transport of wood, hides, etc. Gold had been found in a stream falling into the Southern Tuli.

Colliery Explosion near Wigan

According to the *Annual Register* for 1835, an explosion of firedamp in a coal mine near Wigan on March 9, 1835, caused the death of three women working in the mine. There were only six persons working in the pit, which was a small one, but the pit was known always to contain a great quantity of inflammable gas. Owing to this, a piece of cloth had been placed at the bottom of the pit to assist in ventilating it, but on the day of the accident this was not in place. On a workman, Peter Taberner, going into the colliery with a naked light, he noticed symptoms of an approaching explosion and hastened to get out of the pit, calling the others also to do so. Unfortunately, before they could get out, the explosion took place, burning two men badly, and killing another man and three sisters aged respectively nineteen, seventeen and fourteen years. "Had Taberner," said the *Annual Register*, "taken the precaution of using Davy's safety lamp, instead of approaching with an unguarded light, which as soon as it approached, set fire to the explosive fluid, this accident in all probability would not have happened. He had one of the lamps at home but out of repair, and through the extreme poverty to which he was reduced, he could not afford to get it repaired."

Egyptian Chronology

On March 12, 1835, Henry Hallam, the historian, wrote to Mrs. Somerville directing her attention to an error she had made in her "Connexion of the Physical Sciences". On p. 104 of this work Mrs. Somerville had written: "The Egyptians estimated the year at 365 d. 6 h., by which they lost one year in every 14,601, their Sothiac period. They determined the length of their year by the heliacal rising of Sirius, 2,782 years before the Christian era, which is the earliest epoch of Egyptian chronology." After pointing out that the Egyptian civil year was of 365 days only and the Sothiac period was 1461 years, not 14,601, Hallam said: "I do not see how the heliacal rising of Sirius in any one year could help them to determine its length. By comparing two successive years they could of course have got at a sidereal year; but this is what they did not do; hence the irregularity which produced the canicular cycle. The commencement of that cycle is placed by ancient chronologers in 1322 B.C. It seems not correct to call 2782 B.C. 'the earliest epoch of Egyptian chronology', for we have none of their chronology nearly so old, and in fact no chronology, properly so called, has yet been made out by our Egyptian researches. Certainly, 2782 B.C. is a more remote era than we are hitherto warranted to assume for any astronomical observation."

A History of British Fishes

Among its short notices of new books, the *Athenaeum* for March 14, 1835, referred to "A History of British Fishes" by William Yarrell. "Here is the first number," it said, "of a beautiful work, to be completed in fourteen monthly parts, illustrated by woodcuts of all the species, and numerous vignettes. The name of Mr. Yarrell is sufficient guarantee for the accuracy of the work; and we can assure our readers that the exquisite beauty of the illustrations leaves nothing to be desired. It promises, when complete, to be a worthy companion to Bewick's 'Birds'—and we know not that we could say more in its praise." Yarrell, who was born in 1784 and died in 1856, was a successful business man and head of a newspaper agency. Devoted alike to sport and natural history, he belonged to the Linnean, Zoological and Entomological Societies. His collections of fishes and birds were purchased for the British Museum.

Chemistry at Oxford

In the Lent Term, 1835, Dr. Daubeny began a course of chemical lectures in the basement of the Old Ashmolean Building at Oxford to an audience, some of whom rose to great distinction. Among them were Archibald Campbell Tait, F.R.S., then a newly elected fellow of Balliol, who afterwards became headmaster of Rugby, 1842–60, Bishop of London, 1856–68 and Archbishop of Canterbury, 1868–82; William Dudley Ryder, afterwards arbitrator in the Mixed Court of New York; Reginald Windsor West, seventh Earl Delawarr; and John Bennett Lawes, who had matriculated at Brasenose College in 1833, and who founded the Rothamsted Agricultural Experiment Station ten years later. In those days, it was quite usual for persons intending to take holy orders to attend scientific lectures.

Societies and Academies

LONDON

Royal Society, February 28. J. MELLANBY: The supposed coagulation of oxalate plasma by trypsin. The action is due to the conversion of prothrombase to thrombase by the ionised calcium contained in the trypsin solution. The quantity of calcium required to coagulate oxalate plasma is determined by the thrombokinase content of the plasma. Plasma containing *N*/80 potassium oxalate and an optimal quantity of kinase may be coagulated by the addition of *N*/800 calcium chloride. This fact indicates the avidity of kinase for securing the calcium ions to the prothrombase kinase system. Mammalian blood collected directly into a solution of potassium oxalate obtains kinase relatively slowly from the cells of the blood. The interval of time after leaving the blood vessels is greater than that required for the precipitation of 75 per cent of the total calcium of the blood by the potassium oxalate. G. SALT: Experimental studies in insect parasitism. (3) Host selection. Parasites attack only certain hosts, but why they choose some particular species and reject others is unknown. Two strains of the parasitoid *Trichogramma evanescens*, reared exclusively on *Sitotroga* and *Ephestia* respectively for 63 and 43 generations, developed no dependence on, or preference for, their respective hosts. Both strains preferred *Ephestia*, but the preference was not a specific one for *Ephestia* but a preference for *Ephestia* as the larger host. Ovipositing females of *Trichogramma* attacked a number of true hosts from which their progeny successfully emerged; several unsuitable hosts in which their progeny were unable to develop; and a variety of false hosts in which they were unable even to lay their eggs. The principal criterion used by ovipositing females of *Trichogramma* in the selection of their hosts is that of size. G. FRAENKEL: A hormone causing pupation in the blow-fly, *Calliphora erythrocephala*. This secretion is produced 16 hours before pupation (at 20° C.). The hormone producing organ is either the ganglion or in its immediate neighbourhood. After the hormone has been discharged, pupation can be successfully accomplished without the co-operation of the ganglion. The atmospheric oxygen required for the darkening of the pupa is brought to the skin through the tracheal system.

PARIS

Academy of Sciences, January 21 (*C.R.*, 200, 269–356). The president announced the death of Emanuele Paterno di Sessa, foreign associate. EMILE PICARD: Functions of one variable possessing a theorem of addition. L. LECORNU: The *retour éternel*. ERNEST ESCLANGON: A photograph with long exposure of Nova Herculis. Remarks on a peculiarity present in the photograph taken on January 11, and not appearing in photographs taken on January 7 and 12. MARCEL BRILLOUIN: A heterogeneous electromagnetic ether capable of producing a field of a quantic atomic force. HYACINTHE VINCENT and FRANÇOIS MOREL: The alexic deficit determined by experimental hyperthermy. LOUIS LUMIÈRE: An optical inverter. A modification of the Wollaston prism. CHARLES CAMICHEL, LÉOPOLD ESCANDE and PIERRE DUPIN: Indeterminations in the phenomenon of sudden enlargement (hydraulics): the influence of the initial conditions. ALEXANDRE GUILLIERMOND was elected a member of the Section of Botany in succession to the late H. Locomte. Gérard Cordonnier. A new method of generation of right conoids Silvio Minetti. The search for the exceptional values of a series of analytical functions and a new criterion of normality of a family of such functions Charles Sadron The determination *a priori* of the coefficients of turbulent friction for conduits and rough plates Pierre Vernotte The damping of oscillations of real materials L Goldstein The determination of the potentials of interaction of corpuscles Gaston Dupouy and Raymond Jouaust The absolute measurement of magnetic fields and the determination of the ampere in absolute value Several authors who have made absolute measurements of magnetic fields by the two usual methods, the induction method and the electromagnetic method, have obtained results showing a systematic difference and this has been attributed to the difference between the absolute ampere (deduced from its electromagnetic definition) and the international ampere The experiments described by the author show no such difference The ratio of the international ampere to the absolute ampere deduced from the experiments described agrees within 1 in 10,000 with the value of H L Curtis and R W Curtis (U S Bureau of Standards) Albert Turpain and Raymond de Bony de Lavergne Observations on the communication of M Jacques Métadier relating to the action of the magnetic field on the Brownian motion J Cayrel A method permitting the separate study of the rectification of the two contacts of a rectifier with rigorous elimination of the rectification of one of them Application to the localisation of the β rectification of copper sulphide detectors Paul Gaubert The anisotropy of liquids round gas bubbles Albert Arnulf The resolving power of visual optical instruments and its relations with the optical quality of the instrument K Sitte Remarks on the theory of artificial radioactivity Wolfgang Gentner. The disintegration of beryllium by the γ rays Absorption of the emitted neutrons Effective section of the γ-rays Morice Letort The kinetics of the thermal decomposition of acetaldehyde vapour in the presence of traces of oxygen Pierre Vallet The theoretical study of the decomposition of bodies with linearly increasing temperatures Mme. Marie Elisa P Rumpf Pertitanates and pervanadates Using the method of continuous variations, it was found that the percompound formed corresponds to the action of one molecule of hydrogen peroxide on one molecule of titanium tetrachloride or of sodium vanadate. The equilibrium constants of these reactions were determined Albert Portevin and Pierre Chevenard The micromechanical study of welds An application of the micro-machine recently described by Chevenard Diagrams are given showing the results obtained with welds of chrome molybdenum steels. G Lejeune: Some tartromanganic salts. Jules Jarrousse · The hydrogenation of diphenylpyruvic acid Jean Rudic: The quantity and the nature of the gases evolved under the action of heat and a vacuum by some fossil Rumanian coals Contribution to the classification of these combustibles E. Aubert de La Rüe · The geological constitution of Wallis and Futuna Islands. Gilbert Mathieu: The geological structure of the Vendean Bocage Edmond Saurin: The presence of the Lias in the province of Phu Yen (South Annam) and on the age of the upper grits of south-east Indo-China. Albert F de Lapparent The Tertiary basin of Eoulx, near Castellane (Haute-Provence) Adolphe Lepape The origin of the helium of natural gases Helium and ekacæsium (element No 87) It is suggested that the presence of lithium and cæsium in springs exceptionally rich in helium are indicators of the original presence of the hypothetical alkaline radio element No 87, or ekacæsium, in the strata supplying the mineral matter for these springs Norbert Casteret The gulfs and caverns of the Taza region (Morocco) Robert de Litardière Observations relating to the cycle of the nucleoles in somatic mitosis Jean Chaze and André Sarazin Contribution to the study of the *môle*, a disease of mushroom beds The internal morphology of species of *Psalliota* with parasites Ph Joyet Lavergne Contribution to the search for vitamin A in animal and plant cells Mlle Germaine Cousin A case of gynandromorphism in a hybrid grasshopper, *Achaeta bimaculata campestris*, *A bimaculata* Emile F Terroine and Robert Razafimahery The distribution of the excrementitial forms of sulphur in the various aspects of metabolism Mlle Paule Lelu. The metabolism of imidazol

AMSTERDAM

Royal Academy of Sciences (*Proc*, **38**, No 1, 1935) W J de Haas and J M Casimir-Jonker Penetration of a magnetic field into supra-conductive alloys Extends previous work on tin to Bi_5Tl_3, and a Pb-Tl alloy (64 8 per cent Tl) H ter Meulen and Miss H J Ravenswaay The molybdenum content in leaves The molybdenum content of the leaves of all the trees investigated except the horse-chestnut remained constant or increased between May and October A van Itterbeek and W H Keesom Measurements on the viscosity of oxygen gas at liquid oxygen temperatures Determinations between 90 2° K and 79 4° K by the oscillating disc method L S Ornstein and J W Meyer The velocity of alcoholic fermentation A mathematical theory of the carbon dioxide evolution and sugar consumption in alcoholic fermentation is developed and checked on the authors' and other observers' experimental data R Weitzenbock On restricted semi-invariants of binary forms A A Nijland Mean light curves of long period variables (21) *Z Cygni* The period of this star is 262 days and the amplitude 5·59 magnitudes P J Bouma Outlines of a general theory of the colour metric (1) Extends and completes previous theories by Schrödinger and Thoden v Velzen Julius Wolff Demonstration of a theorem on the conservation of the angles in the conformal representation of a domain in the neighbourhood of a frontier point Kurt Mahler An arithmetical property of the Taylor coefficients of rational functions H Behnke and F Korte Theory of functions of several complex variables The boundary of the region of regularity P Koets Complex coacervation of amylophosphoric acid and proteins and its possible bearing on the problem of amylopectin Viscosity measurements of mixtures of amylophosphoric acid and various proteins and possible interpretation N H van Doorninck The position of the Laki crevasse in Iceland N H van Doorninck The origin of the shield volcanoes and the volcanic table mountains of Iceland Gaston Astre Pericatalan beds of *Pseudotoucasia Catalaunica*. Gaston Astre: A preradiolite from the island of Ibiza. G. v. Ubisch · Influencing the signs of heterostyly in *Oxalis stricta* by *Ustilago Oxalidis* F KRUER Contributions to the knowledge of oxygen respiration in *Ascaris suilla* A. BIEMOND and PH H HARTZ Hypogenitalism in a case of dystopia of the neurohypophysis with special reference to the rôle of the basophilic elements It is concluded that if the gonadotropic hormone is produced by the basophilic elements, it must be transported by way of the pars posterior and hypophyseal stalk W HUREWIEZ. Contributions to the topology of deformations (1) Higher dimensional homotopy groups J F DREYER A human skull from Florisbad, Orange Free State, with a note on the endocranial cast by C U Ariëns Kappers

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, March 11

BRITISH MUSEUM (NATURAL HISTORY), at 11 30 —Miss C E Longfield "A Naturalist in Brazil" *

VICTORIA INSTITUTE, at 4 30 —Dr W Bell Dawson "Solar and Lunar Cycles implied in the Prophetic Numbers of the Book of Daniel"

ROYAL GEOGRAPHICAL SOCIETY, at 5 —Dr Brysson Cunningham "An Inland Water Survey for Great Britain"

UNIVERSITY OF GLASGOW, at 8 30 —J Anderson "Progress in Shipbuilding" *

Tuesday, March 12

ILLUMINATING ENGINEERING SOCIETY (Joint Meeting with the ROYAL AERONAUTICAL SOCIETY), at 7 —H N Green "Recent Developments in the Lighting of Airways and Aerodromes"

Wednesday, March 13

ROYAL SOCIETY OF ARTS, at 8 —S A Main "Properties, Characteristics and Uses of Stainless Steel"

Thursday, March 14

ROYAL SOCIETY, at 4 30 —H J Taylor "The Tracks of α-Particles and Protons in Photographic Emulsions"

M L E Oliphant, A E Kempton and Lord Rutherford "The Accurate Determination of the Energy Released in Certain Nuclear Transformations"

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5 —Dr V B Wigglesworth "Observations on the Malaria Epidemic in Ceylon" *

BEDFORD COLLEGE FOR WOMEN, at 5 15 —Prof C D Broad "Time as a Metaphysical Problem" *

Friday, March 15

PHYSICAL SOCIETY, at 4 45—(at the Imperial College of Science, South Kensington, S W.7) —Annual General Meeting

KING'S COLLEGE, LONDON, at 5 30 —Maj Gen. Rowan-Robinson "Iraq and her Neighbours" *

Saturday, March 16

MICROCHEMICAL CLUB, at 10 30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1) —Annual General Meeting

Official Publications Received

GREAT BRITAIN AND IRELAND

Manual of Safety Requirements in Theatres and other Places of Public Entertainment Issued by the Home Office, 1934 Pp ii + 106 (London H.M Stationery Office) 2s 6d net

Committee of the Privy Council for Medical Research Report of the Medical Research Council for the Year 1933–1934 (Cmd 4796) Pp 172 (London H M Stationery Office) 3s net

Sanatoria List of Sanatoria and other Residential Institutions approved by the Minister of Health for the Treatment of Persons suffering from Tuberculosis and resident in England and Wales, with the names of the Administrative Counties and County Boroughs in which the Institutions are Situate (List 10e) Pp 26 (London H M Stationery Office) 6d net

University of London University College Annual Report, February 1934 February 1935 Pp ii + 183 (London Taylor and Francis)

British Standards Institution Handbook of Information and Indexed List of British Standard Specifications (C D 5050) Pp 93 + xxvi (London British Standards Institution) 1s

Empire Fibres for Marine Cordage Tests of Tarred and Untarred Cordage made from East African Sisal Report of Exposure Tests carried out by the Admiralty, 1933–34 Pp 11 (London Imperial Institute) 1s

Bulletin of the International Tin Research and Development Council, No 1 Tinplate and Canning in Great Britain Pp 82 (London International Tin Research and Development Council) Free

The Journal of the Royal Agricultural Society of England, including the Farmer's Guide to Agricultural Research Vol 95 Pp 537 + cxlvii (London John Murray) 15s

London Shellac Research Bureau Technical Paper No 1 Isolation of Pure Lac Resin By Dr Lal C Verman and Dr R Bhattacharya Pp 24 (London London Shellac Research Bureau)

Brompton Hospital Reports a Collection of Papers recently published from the Hospital Vol 3, 1934 Pp iv + 171 (London Brompton Hospital for Consumption) 2s 6d

The Scientific Proceedings of the Royal Dublin Society Vol 21 Nos 19, 20 and 21 Pollination in *Saxegothæa*, by Joseph Doyle and Mary O'Leary Pollination in *Pinus*, by Joseph Doyle and Mary O'Leary Pollination in *Tsuga*, *Cedrus*, *Pseudotsuga* and *Larix*, by Joseph Doyle and Mary O'Leary Pp 175–204 + plates 3–5 (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd) 4s

Technical Education Series Pamphlet No 3 Flour Quality its Nature and Control By Dr E A Fisher Second (revised) edition Pp 58 (London National Joint Industrial Council for the Flour Milling Industry) 6d net

Report for 1934 (No 47) of the Marine Biological Station at Port Erin, Isle of Man Drawn up by Dr R J Daniel Pp 36 (Liverpool University Press of Liverpool) 1s 6d net

Institute for Research in Agricultural Engineering University of Oxford Farm Wiring By C A Cameron Brown Pp 32 + 4 plates 1s Some Trends in Mechanised Farming, 2 Grass By Dr H J Denham Pp 8 (Oxford Institute for Research in Agricultural Engineering)

Royal Commission on the University of Durham Report (Cmd 4815) Pp 94 (London H M Stationery Office) 1s 6d net

OTHER COUNTRIES

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 115 On a Motion of a Cylindrical Bubble in a Tube and its Application to the Measurement of the Surface Tension of a Liquid By Sin iti Hattori Pp 161–193 30 sen No 116 Investigation of the Accident to the Flying-boat, J-BCDO, "Sirohato" (Report of the Accident Investigation Committee) Pp 194–437 1 90 yen (Tôkyô Koseikai Publishing Office)

The Mysore Tribes and Castes Vol 1, Chapter 1 The Position of Mysore in India's Racial History By Dr Baron von Eickstedt Pp 80 + 21 plates (Bangalore Government Press)

Memoirs of the Geological Survey of India Vol 67, Part 1 The Baluchistan Earthquakes of August 25th and 27th, 1931 By W D West Pp v + 82 + vii + 8 plates (Calcutta Geological Survey of India) 3 rupees, 5s 3d

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès-verbaux des réunions, Vol. 93 Rapport Atlantique 1933 (Travaux du Comité du Plateau continental atlantique) (Atlantic Slope Committee) Publié avec l'aide de Dr Ed Le Danois et Rafaël De Buen Pp 36 (Copenhague Andr Fred Høst et fils) 1 50 kr

Egyptian Government Ministry of Public Works Annual Report for the Year 1928–1929 English Version, Part 2 Pp xii + 375 + 13 plates (Cairo Government Press) 30 P T

Bergens Museum Årsberetning, 1933–1934 Pp 96 (Bergen A/S John Griegs Boktrykkeri)

Carnegie Institution of Washington Year Book No 33, July 1, 1933–June 30, 1934 with Administrative Reports through December 14, 1934 Pp 405 (Washington, D C Carnegie Institution)

CATALOGUES

Minerals, Rocks, Fossils, Meteorites Pp 48 (London Gregory, Bottley and Co)

Radiography in the Erect (Publication No 34/09) Pp 12 (London Newton and Wright, Ltd)

Boots Special Medical Products Pp 32 (Nottingham Boots Pure Drug Co., Ltd)

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Cinematograph Films and the Home Office

RECENT correspondence in the *Manchester Guardian* has directed public attention to a grave risk threatening that general use of cinematograph films in education and research, which has made such rapid and desirable progress in recent years For it is admitted that the Home Office proposes to bring the smaller sorts of cinematograph projectors, and the films on cellulose acetate base which are commonly supplied for use with them, within the scope of new regulations purporting to be made under authority of the Cinematograph Act 1909 in the interest—so it is alleged—of greater safety for the public

Now the Cinematograph Act is concerned solely with the use of apparatus "for the purposes of which inflammable films are used" it gives no authority whatever "for securing safety" in the use of any film which is not inflammable When the Act was passed, in November 1909, scarcely any projectors were in use except those for films of 'standard' 35 mm. width , and scarcely any films were published except on 'cellulose nitrate' base, which is highly inflammable, igniting at about 230° C , and burning with almost explosive violence. It was clearly in the public interest that the use of such a substance in public assemblies and in necessary proximity to an arc-lamp should be strictly regulated

In 1909, however, this defect of the earlier films was already leading to the provision of a substitute, the 'cellulose acetate' base, which does not inflame at all below a red heat, melts before it ignites, smoulders rather than burns, and often extinguishes itself The Cinematograph Act accordingly dealt only with projectors using 'inflammable' films But the 'non-flam' base has even now one serious disadvantage, that it is liable to warp in use, and consequently is not suitable for films so wide as the 'standard' 35 mm gauge

For all 'sub-standard' widths down to 9 mm , and consequently for cheap and portable projectors, adequate for school classes and other small audiences, as well as for laboratory work and private entertainment, the 'non-flam' film has revolutionised cinematography, as the Kodak camera with its roll-holder of film negatives revolutionised photography forty years ago Schools of all grades, laboratories and museums, clubs and churches, have been equipped with sub-standard projectors, thousands of film exhibitions are given annually with the same freedom as lantern lectures, and many lantern slides, too, are now made on 'non-flam' base, which is both lighter and less fragile than glass For Kodak negatives the 'non-flam' film has practically driven out the earlier bases, some of which were dangerously inflammable No accident from a public exhibition of 'non-flam' film has ever been reported · a solitary mishap at Dulwich College was shown to have resulted from the inadvertent issue of an inflammable film from a Government department The Post Office has now its own film factory and issues 'non-flam' films for public use. The Board of Education allows large sums to be spent to install 'sub-standard' projectors for open use in schools

The Cinematograph Act, however, did not define an 'inflammable' film, and the Home Office, after leaving sub-standard projectors, with their 'acetate'-base films, unmolested for nearly twenty-five years, has now admitted, under question, that it is intended to "adapt the regulations to present conditions" and that "one of the points to be dealt with is the relaxation, in favour of slow-burning films, of certain requirements necessary for fast-burning films". The implication here is that all films are "inflammable" within the terms of the Cinematograph Act, and that unless and until the Home Office "relaxes" its regulations, any film exhibition is liable to be regarded as a breach of the Act, unless it takes place under the very stringent regulations proper for 'standard' size films on 'nitrate' base

It is difficult at first sight to believe that there is anyone who wishes to restrict the free use of sub-standard projectors or the general employment of films in private, in education and research, or in places of entertainment other than those larger halls where 'standard' projectors, and (consequently) inflammable films are still indispensable But the premature glee with which certain newspapers have proclaimed the end of the 'non-flam myth' seems to betray such a desire; and it is obvious that if people can see the kinds of films they desire, co-operatively, safely and at small cost, without 'going to the pictures', it is not very good for interests which at one time had almost a monopoly of the cinema, as professional photographers monopolised photographs and lantern-slides before the days of the Kodak.

It is especially unfortunate, also, that this outcry about 'non-flam' films should have been, confused in some minds with the quite different question whether private, social and educational exhibitions should be 'censored' or otherwise controlled in the supposed interests of morality, political orthodoxy, or what are popularly described as 'box-office' considerations. For, whereas 'non-flam' films and sub-standard projectors have until now been free from official interference on the ground of public safety, most authorities responsible for licensing halls for the exhibition of 'standard' and therefore 'inflammable' films, though legally concerned only with the personal safety of audiences, have in fact agreed to permit in their areas only films 'approved' by the British Board of Film Censors, a body which was set up by the film trade itself, shortly after the Cinematograph Act was passed

This confusion of public safety with public morality has been the weakest point in British film administration throughout. If the public needs protection against improper or subversive films, it would seem reasonable that this should be assured under the laws regulating improper or subversive behaviour in general If a censorship should be deemed unavoidable, let us have an official censor, responsible to one of the Secretaries of State, not to the 'trade', which has an interest in the matter, and not always a British interest.

Further, if "for securing safety" the Home Office wishes to "adapt the regulations to present conditions", it can make sub-standard projectors as safe and foolproof as their recognised public utility demands, simply by making it an offence, under the Cinematograph Act or otherwise, to manufacture or offer for sale films on 'nitrate'-base of any width less than the standard 35 mm size Any restriction or discouragement of the present general use of the sub-standard projector would be a disaster in public education, and also in the many branches of scientific research and teaching in which this valuable piece of apparatus is employed

The National Institute of Sciences of India

FURTHER details of the Indian Institute of Sciences, to which brief reference was made in NATURE of January 12 (p. 59), are now available. Elsewhere in this issue (p. 441) we print an article summarising the circumstances of its inception and recording the proceedings of the inaugural meeting. The desirability of having in India a national academy has long been felt, and this found expression a year ago in the appointment by the Indian Science Congress of a strong committee to elaborate a scheme for the establishment of an All-India Academy It was feared by many that the work of this committee might have been jeopardised by the registration last June of an 'Indian Academy of Science' by Sir C V Raman in Bangalore There were thus three bodies of 'academy' standing in India, the premier society—the Asiatic Society of Bengal—the United Provinces Academy of Science, and the new Indian Academy of Science Fortunately, the common sense which has always been such a marked feature in the organisation of the Indian Science Congress, has enabled its committee to surmount all apparent difficulties and to secure the adherence of the officials of these three societies to the new Institute

The Institute, with its headquarters in Calcutta, has received the support of all the most prominent men of science in India, it has started with one hundred foundation fellows, and in the future not more than ten will be elected annually. The fellowship will obviously, therefore, be a much prized distinction and since it is intended later to apply for a Royal Charter, the Institute will in effect become a Royal Society of India It is not proposed that the Institute should publish a journal, publication will remain as one of the functions of the co-operating academies, which it is anticipated will be increased by the formation of academies in Bombay and in the Punjab It will, however, issue a Proceedings summarising the papers read before these societies, and it will be prepared to assist them in the publication of expensive memoirs An annual report, reviewing the progress of science in India, will also be issued, thus reviving on a broader basis that prepared formerly by the now defunct Board of Scientific Advice The Institute proposes also to organise symposia on subjects of general and scientific interest A further activity, on which emphasis is laid in the presidential address, will be "to promote and maintain a liaison between men of science and men of letters" Whilst a National Institute of Arts and Letters has still to be formed, the desired liaison has been effected in an indirect manner by the fact that one of the co-operating academies, the Asiatic Society of Bengal, is both an academy of science and of letters

Of far greater importance, however, in our opinion, are two other functions referred to by Dr Fermor (*a*) to appoint committees to which the Government and other bodies can apply for advice, and (*b*) to secure and manage funds and endowments for scientific research We advocated recently (NATURE, **134**, 789, 1934) the formation in India of a National Research Council, and these two functions, if fully exploited, will in effect make the Institute such a Council We understand that the Government of India has allocated a grant of 12,000 rupees (£900) per annum to the Institute, and we do not doubt that further funds, from both public and private resources, will be placed at its disposal

The formation of the National Institute is the most important development in the organisation of scientific activities in India which has occurred since the foundation in 1913 of the Indian Science Congress It is but fitting that the Institute should owe its inception to this body

Reviews

Embryology—Biological, Philosophical and Theological

A History of Embryology By Dr Joseph Needham. Pp xviii + 274 + 16 plates. (Cambridge At the University Press, 1934) 15*s* net

LOVERS of Tristram Shandy will remember that passage in which Sterne gives a cut of his ironic whip at the learned Catholic doctors of the Sorbonne, who in their zeal to save souls had given a very precise account of the principles governing the baptism of unborn children, not forgetting detailed practical instructions for achieving it "avec une petite canule sans faire aucun tort à la mère". The Anglican divine suggested a more embracing method, "of baptizing all the *homunculi* slap-dash" beforehand, which he assures his readers could be done "avec une petite canule sans faire aucun tort au père"

We have here a very good example of the interweaving of theological and biological embryology. The *homunculi* are of course the spermatozoa, in the head of which, certain early microscopists had averred, miniature men had their habitation, ready to expand their preformed anatomy in the nutritive soil provided by the female Some had insisted that they had actually observed the manikins, others had achieved the almost greater feat of asserting their existence on grounds of logical necessity. (Was it not the great Bonnet, writing on the allied subject of preformation, who claimed the fantastic doctrine of *emboîtement*, according to which our first parents contained all future generations, after the fashion of Chinese boxes in an infinite regress, as "one of the greatest triumphs of rational over sensual conviction".)

In any case, it was the biological discoveries of the seventeenth microscopists, quite apart from their metabiological speculations, which enabled the eighteenth century Sterne to reduce *ad absurdum* the arguments of the theologians, based as they were upon the facts and ideas of an earlier age

Embryology is full of such interactions How could it be otherwise when the recurrent miracle of generation is concerned ? Let us remember that it was not until the middle of the eighteenth century that the early stages of development, demanding the microscope for their elucidation, were in any animal adequately described , and not until the middle of the nineteenth that fertilisation was observed, the concept of the continuing stream of life established, and proof given of the essentially equal contributions made by father and mother to the offspring. Yet offspring were all the time being produced With their production, the gravest questions were bound up—scientific, philosophical and theological. It was imperative to give some answer to these questions, for not only will the speculative itch not be denied, but also far-reaching theories of existence and practical problems of personal salvation hinged upon them. In the absence of any real basis of fact or any framework of established scientific principle, speculation both could, and did, run riot.

Dr. Needham's book, which covers the history of embryology up to the beginning of the nineteenth century, is essentially a history of the invasion of this speculative orgy by hard-won fact and dawning experiment The invasion has been slow, and now and again, as in the Dark Ages, was hurled far back. But on balance it progresses, until by the early eighteenth century it has established a permanent footing and prepared the way for the increased momentum of its subsequent advance.

Embryological knowledge and speculation are conditioned by their environment. In certain cases, factual advance is shown to depend upon technical achievement. The most obvious example of this was, of course, the advance consequent upon the invention of the microscope. Dr. Needham points out, however, that it took longer than might have been expected for embryology to take advantage of the new tool ready to its hand. Harvey, for example, seems never to have utilised anything but hand lenses Or the temper of the time may prevent the speculative men of science from utilising the resources available to them. The general contempt in which manual labour and the mechanic arts were held in classical Greece diverted into mere speculation much energy that might have led to real advance In such periods as the Middle Ages, when the dominance of theological principles prevents the appeal to fact and experiment, and those like the eighteenth century when pure reason is enthroned above the pedestrian senses, men take to the wings of speculation, and distort their thinking with deduction from preconceived principle We have cited the example of Bonnet Another is the belief that the shape of the egg will enable one to prophesy the sex of the chick This is based on the two principles that the circle is the perfect form, and that the male sex is more perfect than the female from which it inescapably follows that cockerels will hatch from the less pointed eggs

This overflowing of scientific speculation into abstract principle may have important practical consequences. Aristotle, as is well known, advanced the theory that the mother merely provided the soil in which the seed of the male might grow and develop Dr Needham points out the bearing of this view on the growth of the patriarchal system of social organisation, and on the widespread practice of killing captured males but keeping the women as slaves and concubines Or again, we may refer to the speculations concerning the entry of the soul into the embryo With the rise of Christianity, these became of practical importance Since according to canon law the embryo has a soul from the fortieth day onwards, the embryo that dies unborn is condemned to damnation if it be not baptised ; and this led to occasional barbarities in cases of obstruction of birth. More important, it led to the view that abortion was murder, a view duly reflected in a change in practice and in law. Both the Greeks and the Romans had taken a lenient view of abortion, or like Plato and Lysis had actually defended it ; but from the fourth century A.D. onwards it became both a sin and a crime. It will be of great interest to see what effect modern discoveries concerning the nature of fertilisation and the facts of early development will have on the theological and moral attitude to the problem. Already in the eighteenth century we saw Sterne pushing logic to its conclusion with his proposal for spermatozoan baptism ; and now that, with the progress of endocrine research, we are likely to wake up any morning to the discovery of a physiological method of preventing implantation, or of dislodging the early embryo from the uterine mucosa before it has established its vascular nutritive system, we may speculate whether some subtle distinction may not be drawn between an embryo and a mere blastocyst, between criminal abortion and permissible denidation. There is much virtue in terminology.

Dr. Needham is fully alive to the implications of the Marxian view as to the conditioning of scientific advance by economic conditions, and makes some valuable comments on the bearing of the social and economic status of the medical man and the midwife upon the advance of embryology. One of his most interesting sections is devoted to a discussion of the various 'limiting factors' affecting steady scientific advance. Among these he distinguishes the relation of the scientific worker to his environment, both the economic environment and the environment of idea; the degree of co-operation among investigators and scholars, including the provision of facilities for publication; material technique, such as fixing reagents, the microscope and the microtome; mental technique in the shape of convenient terminology, fruitful concepts and general attitude; and finally the proper balance between speculation, observation and experiment. As he says, "We may thus regard the progress of knowledge . . . as governed by a reaction-chain, one link of which may at any given time be slower than all the others, and hence may set the speed for the whole".

Of course, Dr. Needham's book is not mainly concerned with such general ideas. They emerge in relation to the historical facts. These are set forth in detail, in many cases with a new emphasis, and often with the inclusion of new or little-known material. But, although they constitute the backbone of the book, within the limits of a review we cannot touch on them.

To tell such a story adequately needs biological and historical knowledge, familiarity with the basic problems confronting embryology to-day as well as a sympathetic insight into those that confronted it at different periods in the past, industry, miscellaneous learning, and a philosophic spirit. Dr. Needham is one of the few biologists to possess these varied qualifications, and the result is a valuable contribution to the subject.

Naturally, there are a few points for criticism. Many who are impressed by the plasticity of the regulatory phase of development and by the modifiability of the embryo through environment will quarrel with the description of modern embryology as 'predetermined epigenesis'. To the author's citations on p. 292 concerning the dangers of too firmly-held speculation, he might have added the obstinate resistance of the phylogenetic embryologists in general and the full-blooded believers in recapitulation theory in particular to the advance of *Entwicklungsmechanik*. He is scarcely fair (pp. 40–41) to the very real and deep difference between the true teleology which appeals to final causes and the pseudo-teleology which is the necessary outcome of accepting natural selection as a *vera causa* in evolution.

At the close of his volume Dr. Needham appears unduly gloomy. "Experimental embryology," he writes, "Morphological embryology, Physiological embryology, and Chemical embryology form to-day a vast range of factual knowledge, without one single unifying hypothesis . . ." Here we cannot follow him. On the morphological side, the broad ideas of comparative phylogeny still hold, the principle of recapitulation, however shorn of its formal absolutism, still yields indispensable service. On the chemical side, Dr. Needham himself has demonstrated the adaptational and phylogenetic meaning of certain large bodies of fact, for example the biological meaning of the numerous facts centring round the cleidoic egg. Elaborate developmental processes like amphibian metamorphosis are proving amenable to a physiological explanation. It is being shown that mutation is affected by differentiation; the expression of genes, such as that of Himalayan coat colour in rabbits, has been explained in terms of position and physiology; and the concept of rate of action, both for the effects of individual genes, for the co-ordination of complex processes of differentiation and for growth, is proving exceedingly fruitful in the hands of Goldschmidt, Ford, Witschi and others. In experimental embryology, the distinction between the plastic and the determinate phase and the realisation that the time of onset of the latter can be shifted, has broken down the old distinction between 'regulation' and 'mosaic' eggs, and established a comprehensive unity. The mathematical formulation of growth, both absolute and relative, is becoming serviceable. The earlier speculations of Child are being reshaped by Weiss and Waddington into a serviceable field theory. The work on organisers (to which again our author has made his distinctive contribution) is linking up certain important facts of embryology with the general theory of hormones.

Many of the principles that are emerging are still themselves, it is true, somewhat embryonic; but they exist, and will develop. We cannot expect, in such a complex subject as embryology, to find a single all-comprehensive unifying principle, any more than we expect it in physiology or biochemistry. Dr. Needham has promised us a sequel to the present volume, to cover the nineteenth century and modern periods of embryology. It will be eagerly awaited; but it is to be hoped that he will recover his theoretical optimism before undertaking it.

J. S. H.

Science and Citizenship

The Frustration of Science By Sir Daniel Hall, J G Crowther, J. D Bernal, Prof V. H Mottram, Dr. Enid Charles, Dr P A Gorer, Prof P M S Blackett Foreword by Dr Frederick Soddy Pp 144 (London George Allen and Unwin, Ltd , 1935) 3*s* 6*d* net

AMONG the more hopeful signs in the last two years is the growing sense of social responsibility among individual men of science, and the widespread impatience with sabotage of foodstuffs or other products in a world in which hundreds of thousands are still insufficiently nourished or clothed Naturally enough, both scientific workers awakened to a sense of social responsibility, and the ordinary citizen indignant at so much poverty and distress in the face of the incredible abundance with which science has endowed mankind, have been more concerned to find ways and means of appropriate action than to pause to establish the fundamental causes of this startling but distressing paradox If, however, we are to make constructive suggestions and evolve a wise policy rather than adopt temporary expedients or palliatives, it is essential that diligent inquiry should be made into the underlying causes of what has rightly been termed the frustration of science

The bitter charge that science has enthroned the wastrel holds too much painful truth to be ignored Common prudence warns us of the dangers of continuing to place more and more power in the hands of those intellectually and morally incapable of using it wisely Even if men of science as a whole have been much too prone to adopt an attitude of indifference to social questions or even to regard original thought on these matters as socially dangerous and professionally reprehensible, not even the most cynical could charge the scientific worker with the deliberate prostitution of his discoveries and inventions to the infliction of suffering, the multiplication of unemployment, or of the risks and horrors of war.

The essays which appear in this volume, following a foreword by Prof F Soddy, demonstrate most effectively how impossible it is for the scientific worker to remain indifferent either to the social and economic consequences of his work, or to those forces which determine even the direction which his work shall take

Inevitably some provocative matter is to be found in a book of this type, but its arguments are the more impressive because no claim is advanced for exceptional powers for scientific workers as a class, as compared, for example, with politicians. On the contrary, the tendency to place all the blame on the politician is vigorously attacked The book pleads not so much for the participation of the scientific worker in the actual task of government on such lines as those outlined by Prof Miles Walker in a well-known address, or even of the contribution of a detached, scientific attitude to political questions, as for the body of scientific workers to throw in their lot with one or other of the main contending forces

This contention will no doubt disappoint many who believe that the study of difficult political, social and economic questions by the scientific method is a most fruitful line of advance Such scientific workers will, however, find a good deal of food for thought in the frank disclosure of forces which at present prevent any such attitude of mind or attack on these questions The problem as visualised by this book is that of securing the conditions in which a scientific approach to these questions becomes possible

The facts marshalled in support of this thesis sometimes make bitter reading What a bankruptcy of mind and leadership, for example, is betrayed in proposals to restrict output in face of over-production when more land, more labour, more skill are still required to supply the greater part of the population with the mixed dietary of a better-class family in place of a diet almost exclusively existing of cereals. The application of science to the distribution of the productive capacity of the world and to the government of its peoples demands a wealth of directive skill and a technique of national organisation which necessitate in effect a social revolution as well as a complete change of outlook

Aviation tells the same story. Contrary to popular belief, technical development in war-time is slower than in peace-time, although the British expenditure was four times as great in 1914–18 Long-distance aviation has been severely frustrated by the refusal of Governments to allow air routes to be operated in the most economical and effective manner over their territories. "First over Everest" contains painful evidence of the hindrances in the way of science placed by nationalistic Governments and military needs, and J G Crowther asserts that aviation will remain frustrated as long as it is not conducted primarily to serve the creative classes

Even the chapter on science and industry discourages any easy optimism that all is well here also. The waste of expenditure on war research, the inefficiency of scientific work in the universities, the general lack of direction of research even in physical science, and the loss of freedom on the part of the scientific worker, are all matters on which Mr. J. D. Bernal causes us furiously to think. Again, there is the still considerable time-gap between theoretical discoveries and their application, the immense amount of technical knowledge still unappropriated by society or industry even for the relief of suffering, the way in which the economic structure itself opposes technical change and the adoption of new methods or standards of living, limiting alike expenditure on research and utilisation of existing knowledge.

This sombre picture of the way in which scientific development may be held up by lack of support or turned to trivial or destructive uses cannot be ignored by the man of science He at all events should see through the fallacy of a demand for less science and a return to simpler times, when what is really needed is the application of science to the convenience of living instead of to profit-making Nor can he fail to be alive to the danger of the degeneration of science under what is called economic nationalism, and the narrowing of its functions, or the way in which professional efficiency and a scientific outlook in the practitioner are threatened by the conditions under which he is called upon to practice, as in the medical profession to-day

The exact relations between scientific workers and political organisations may be open to debate There can be no question, however, as to the need for much more open-mindedness on the part of all men of science towards the social and industrial problems of their environment to-day Even from the point of view of the advance of science itself they must face those problems Much more must they accept the challenge, corporately and individually, if they care anything for the enrichment of mankind with the vast resources of material well-being and leisure which science has now put within our power That era of plenty can only be achieved as men of science face frankly such problems as are presented in this book and, faithfully proclaiming the truth, strive as earnestly and disinterestedly for their solution, for the distribution of wealth and the science and art of living as in the past they have striven for the acquisition of the knowledge which places an age of plenty and of leisure within the reach of all

R B

Development of High-Speed Aircraft

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1575 *Collected Reports on British High Speed Aircraft for the 1931 Schneider Trophy Contest* Pp iii+100+60 plates (London: H M Stationery Office, 1934) **10s. net.**

THIS monograph describes the development of the British aircraft for the Schneider Trophy contest of 1931, the preparations for and the actual contest, also the successful attempts on the speed record afterwards It is mainly concerned with the technical aspects, although a tribute is paid to the great skill of the pilots, without which the successes could not have been achieved

The book is divided into sections, each written by the persons mainly responsible for the work described, and although it forms a connected whole, the individual reports are self-complete

Section 1 is an introduction by H M Garner, giving a brief description of the history of the 1931 contest and a summary of the contents of the monograph In Section 2 the development of the design and construction of the *S 6A* and *S 6B* are described by R J Mitchell, the chief designer of Supermarine Aviation Co (Vickers), Ltd Although the design was based on the *S* 6, the Schneider Trophy winner of 1929, there were a number of problems which required further solution, and these were dealt with by Mr Mitchell in co-operation with the Air Ministry and National Physical Laboratory staffs Probably the most difficult problem was the provision of adequate water- and oil-cooling

Section 3 describes the development of the engine by Messrs Rolls-Royce, Ltd Although the external shape of the 1929 engine was scarcely altered, almost the whole of the working parts of the engine had to be re-designed The airscrews were all of the Fairey-Reed type, and a description of the development of them is given in Section 4

Section 5, describing the wind tunnel tests, is written by the National Physical Laboratory staff The tests were made on as large models as possible in the Duplex wind tunnel at the National Physical Laboratory in order to reduce the scale effect For the first time in the history of these contests a large amount of full-scale data was collected This is described in Sections 6 and 7 and also in a separate report (R and M 1472)

The flying experiences of the high-speed flight are summarised in Section 8, and the medical aspect of high-speed flying is discussed in Section 9.

The monograph concludes with Section 10, giving a short descriptive account of the Schneider Trophy contest and the two speed record flights It is evident that the speed in the contest could have been improved had not instructions been given to take no risks on the turns and to keep the water temperature of the engine at a safe level by throttling A subsequent speed record flight of 407½ m p h was made

The monograph illustrates the many aspects of aeronautical research which have to be considered in the development of racing aircraft. It should certainly be read by all aircraft designers, and in a broader sense it is an excellent example of how scientific and technical experimentation upon a specific question should be organised.

Short Notices

The Generic Names of the Holarctic Butterflies By Francis Hemming Vol 1 *1758–1863* Pp viii + 184 (London British Museum (Natural History), 1934) n p

THIS book aims at providing a list of generic names proposed for the holarctic butterflies between the years 1758 and 1863, inclusive It also attempts to give the correct fixation in so far as typical species, or genotypes, are concerned Mr Hemming has based his results and conclusions on an exhaustive first-hand examination of the whole of the literature concerned. Entomological workers have long been hampered by doubts obtaining relative to the correct names of so many of the insects they study Among these uncertainties, generic names are paramount, while specific names are of lesser importance and would prove of little difficulty once uniformity of generic nomenclature could be attained

With few exceptions, the strict application of the present International Code of Nomenclature has been followed, in certain instances widely used names, especially those of insects of economic importance—the strict application of such rules would result in unnecessary confusion It is, therefore, suggested that with regard to seven well-known genera, the application of the rules be suspended and that such names be placed in the list of *nomina conservanda.* In the appendix at the end, the relevant articles of the nomenclature code that have been followed are given and are thus available for ready reference It is to be hoped that the International Commission of Zoological Nomenclature will, as soon as may be possible, exercise its plenary powers and decide in favour of the recommendations put forward Mr Hemming has evidently carried out his task with great care, and the result of his labours will be welcomed by lepidopterists of both Europe and North America

Ancient Egyptian Materials and Industries By A. Lucas Second edition, revised. Pp xii + 447. (London · Edward Arnold and Co , 1934) 16*s* net

IN this volume the author has published with a change of title a second edition of his "Ancient Egyptian Materials" (1926) Those who are acquainted with the book in its earlier form will scarcely need assurance of the merits of the revised edition The author has incorporated much fresh material, which has accrued from his further researches Three chapters have been added as the result of much expansion and rearrangement ; and the ancient industries, which received little more than mention, have now been treated in some detail. Among the industries with which Mr Lucas deals are faience- and glass-making, metal-working, pottery-making and stone-working, while among the new materials added are coral, cosmetics, perfumes and mother-of-pearl. Many additions have been made to the references from the Greek and Latin writers, and the chemical analyses, now much expanded, again appear as an appendix.

Electrolytes By Prof Hans Falkenhagen Translated by R. P Bell (International Series of Monographs on Physics) Pp xvi + 348 (Oxford : Clarendon Press, London Oxford University Press, 1934) 25*s* net.

DESPITE the existence of some excellent English works on the subject, this translation of Prof Falkenhagen's treatise is a very opportune addition to physical literature The book is thoroughly physical in its outlook, and the mathematics employed serves to clarify and to emphasise the physical concepts

A notice of the work would become a mere catalogue if it attempted to give the reader an adequate notion of the topics dealt with ; suffice it to say that the book begins with Faraday, and, after discussing ideal dilute solutions and weak electrolytes, proceeds by way of Lewis's theory of activities to a study of those theories involving interionic actions which have, during recent years, dominated the subject

It is sufficient commentary on the rapidity with which the subject is developing to note that this volume—a translation of the German edition of 1932—has been brought up to date by the addition of sections dealing with recent extensions of Bjerrum's theory, with Onsager's treatment of the dissociation field effect, and with applications of quantum mechanics to electrode processes

Scholarly and very fully-documented, the book is indispensable to any serious student of electrolytic phenomena A F

Palestine and Israel Historical Notes By Sir Flinders Petrie Pp 99 + 16 plates (London Society for Promoting Christian Knowledge, 1934) 3*s* 6*d* net

SIR FLINDERS PETRIE here describes in popular form the contacts between archæology and scriptural narrative of early Israelitish history, mainly in the results of the excavations of the British School of Archæology in Egypt in Southern Palestine The cardinal point of his argument, however, is the consistent character of the patriarchal narrative, when the years of the Biblical account have been subjected to amendment on lines for which there is strong grounds of probability The later dating of the Exodus is then shown to fall into place

The treatment of the Biblical text throughout is essentially conservative The author holds that the results of textual criticism are largely irrelevant. The narrative is not a jumble of sources little better than fortuitous, but, he maintains, can be shown to be a carefully considered selection from a variety of sources in the construction of a complicated, but consistent, story

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WE regret that in referring to "The Kinetic Theory of Gases", by Prof Leonard B Loeb, in NATURE of March 9 (p 390), the publisher's name was incorrectly given as Messrs. Chapman and Hall, Ltd. The book is published by The McGraw-Hill Publishing Co , Ltd , Aldwych House, Aldwych, London, W C.2.

The Uses of Rubber

By G. E Coombs

THE rubber industry of to-day is concerned almost exclusively with the exudation which results from wounding certain of the tissues of *Hevea brasiliensis*, a large tree 80–100 ft tall which is indigenous to the Amazon basin The tree will grow almost anywhere in the belt 10° north and south of the equator, though it does not compete economically at elevations above 2,000 ft Its translation from the Amazonian forests to plantations in the tropical Middle East is a romantic story associated with the names of Markham and Wickham

The development of these plantations has been very rapid, the area having increased by fifteen times in the past twenty years, until to-day the production side of the industry is concerned with 7–8 million acres of plantations, chiefly in British Malaya, Netherlands Indies, Ceylon and French Indo-China, capable of producing more than a million tons of the product annually This enormous aggregate area carries the progenies of the seeds collected by Wickham (1876) from the Amazon basin

The exudation referred to above is known as hevea-latex, since *Hevea brasiliensis* is only one of some four hundred plant species which elaborate juices containing rubber or rubber-like substances It is generally ivory white in colour, and tends towards the consistency of cream It has practically the same density as water, and an average sample contains 35 per cent of rubber as a colloidal suspension of tiny globules which are negatively charged. Rubber itself is an unsaturated hydrocarbon with an empirical formula $(C_5H_8)_n$, where n possibly approximates to 1000 The suspension is very unstable, and if left to itself it develops acidity, when its globules coalesce to produce a coherent junket-like coagulum Once the latex is coagulated it is not possible to reverse the process and recreate the suspension The coagulation can be speeded up and be made complete by, for example, the addition of dilute acetic acid It can also be prevented by the addition of ammonia, whereby the latex is kept 'sweet' and stable. In such condition it can be concentrated by creaming or centrifuging; further, with the addition of protective colloids, for example, soaps, glue, casein, etc., it can be concentrated by evaporation

Very little is known of the biochemical processes which lead to the formation of latex in the tree, or of the rôle it plays in its life-processes. It occurs, and is probably elaborated, in a definite system of branching tubes, associated with the vascular tissue of the tree, which finds its highest development and greatest density in the inner bark of the base of the trunk, whence it is procured by 'tapping' Speaking generally, the raw rubber of commerce is merely the dried coagulum of hevea-latex, and except for the preparation of preserved latex, an operation confined as yet to a few estates, the producing side of the industry finishes with the shipment of the dried product This product is of limited utility Among other things it becomes tacky with heat, stiffens with cold, and perishes with age Early attempts to use it entailed its reconversion to liquid form by the use of solvents (Peal 1791 and Mackintosh 1819)

The rubber manufacturing industry of to-day was made possible by two empirical discoveries Hancock (1820), seeking to shred the material on spiked rollers, discovered that the operation produced a plastic mass which could be moulded to shape This process of mastication remains to-day as the preliminary in practically all manufacturing operations We now know that oxidation and the generation of heat are the factors responsible When, however, Goodyear (1839) and Hancock (1842) discovered independently that raw rubber subjected to heat in the presence of sulphur produced a much toughened product, relatively insensitive to temperature changes, and possessing a large number of other desirable properties, the foundations of the industry were laid The reaction is known as vulcanisation The chemistry and physics involved in it are obscure These two discoveries made possible the transformation of raw rubber into a plastic mass, the incorporation of softeners to ease manipulation, of reinforcing ingredients, of anti-oxidants which preserve its properties, of inert materials which cheapen its products, and of accelerators which speed up the vulcanising process

The science and art of the technologist enable us to-day to produce materials presenting wide ranges of colour, density, elasticity and resilience, specific electrical resistance and resistance to abrasion, products can be made which are impermeable to liquids and gases and resistant to corrosive chemicals There are endless combinations of desirable qualities which can be brought together to serve specific purposes In a survey of the latter, however, it is necessary to distinguish between the following latex, rubber solutions, soft vulcanised products and hard vulcanised products, all these represent different physico-chemical forms of rubber

Latex is comparatively new in industrial applications, and one of the most important discoveries in connexion with it is that the rubber can be vulcanised in its natural 'aqueous' form It is rapidly replacing solutions of raw rubber in coal-tar naphthas, in the treatment of tyre fabrics, in spread- and dipped-goods It is of special value in the manufacture of sponge rubbers and electrically deposited rubbers, and—looking to the future—its use as a binder, either as a main or auxiliary material, bids fair to penetrate far and wide in industry.

The common solvent for raw rubber is coal-tar naphtha Solubility is increased by previous mastication of the rubber, though this treatment decreases subsequent adhesive properties Uses here lie chiefly in the field of adhesives and fabric proofing

If the process of vulcanisation is carried out in the presence of excess sulphur, vulcanite or ebonite (hard vulcanised rubber) is produced The two main fields of application are electrical insulation and corrosive resistant goods, such as linings for conveyors, storage tanks and pipes

There remain the soft-vulcanised products, and it is in this category that rubber displays its amazing versatility. Its applications are literally too numerous to mention

A rough index of proportionate industrial absorption of rubber based on American data is approximately automobile industry 80 per cent, footwear industry 9 per cent, electrical industry 1 per cent, fabrics 1 per cent, surgical goods 0 5 per cent and the balance in toys and novelties, floorings, etc

Of the fundamental problems concerned with the constitution of the rubber hydrocarbon molecule, the process of vulcanisation, now almost a century old, the action of accelerators and the colloidal system presented by rubber-latex, relatively little is known, and it is surprising that the technologist has been able to advance so far without more aid from fundamental research. That his advance has been substantial is a matter of universal experience, but he who would make his experience more intimate and widen his knowledge of a young industry with great potentialities, will find profit in a visit to the Rubber Exhibition at the Science Museum, South Kensington

This exhibition is a very comprehensive one, and its sponsors have met with a full measure of success in their efforts to make it educative. A wide field is covered from the planting of the *Hevea* seed The exploitation of the bark, the processing of latex to produce plantation grades of raw rubber, the milling and compounding of the latter to produce articles of everyday use, are shown It is not possible to deal more than briefly with the general sections of the exhibits

The plantation section shows the lay-out of an estate and the work involved in good husbandry, the prevention of soil erosion, measures of prophylaxis against disease, the economic tapping systems and the operations involved in re-stocking, by the propagation of pedigree buddings An exhibit of particular interest to the layman is the display of latex, since, while it was recorded as long ago as 1781 that this material could be preserved by the addition of certain alkalis, it was not until 1920, when bulk shipments were sent in the ballast tanks of steamers from Sumatra to America, that it became important industrially. How important it is now will be evident when the visitor sees rubber-thread, sponge rubber and dipped goods made from it

The manufacturing section, besides showing the latex applications, shows the machinery for milling, compounding and vulcanising in actual operation.

The scientific section is of special merit in demonstrating the varied contributions of science to the development of the industry Demonstrations are staged showing the Brownian motion of the latex globule and its movements in an electrical field, the technique involved in dissecting the rubber globule, operations of creaming, centrifuging, homogenising and coagulating The student technologist can revel in plastometers, viscometers, durometers, etc He will be attracted by an ingenious device demonstrating the relative activity of various accelerators He will be able to inspect a Wiegand's pendulum and demonstrate to himself the Joule effect He should take this unique opportunity to inspect a well-arranged, though congested, set of valuable instruments and apparatus.

The section dealing with applications ranges from the service of the product in the automobile industry to almost the complete fitments of a surgical theatre

The historical section contains the original plaster study of the bust of Sir Henry Wickham, seeds of the original collection made by him in the Amazon basin, and such interesting exhibits as Hancock's experimental machinery.

There is one inconspicuous exhibit of special interest to the research worker This contains expanded chlorinated rubbers, oxidation products of rubber, and a variety of new products which touch the fringe of what must be a field of great possibility, namely, the use of rubber as a raw commodity for the manufacture of other substances. In this connexion, we have recently learned that rubber is amenable to hydrogenation.

Exhibitions of this nature are very difficult to organise, and the best-organised of them can be prodigal of a visitor's time. To minimise this, the sponsors have made available a carefully indexed guide. This reaches a high standard and the visitor will find it very informative and almost indispensable

International Union of Pure and Applied Physics

REPORT OF THE COMMISSION OF SYMBOLS, UNITS AND NOMENCLATURE

IN 1931, the International Union of Pure and Applied Physics appointed a commission consisting of Profs Keesom, Kennelly and Fabry under the chairmanship of Sir Richard Glazebrook, with Dr Ezer Griffiths as secretary, to deal with the general questions of symbols, units and nomenclature. This Commission submitted its report to the General Assembly of the Union at its meeting in London on October 5 last, and the following resolutions were authorised for publication.

THE STANDARD THERMAL UNIT

(1) The unit of heat when measured in units of energy shall be the Joule, defined as equivalent to 10^7 ergs

(2) The gram-calorie is the amount of heat required to raise the temperature of one gram of water from 14.5° to 15.5° of the International Scale of Temperature under normal atmospheric pressure

As a note on recommendation (2), it is stated that according to existing measurements, the gram-calorie is equivalent to 4.18_6 Joules, and that pending a decision by the International Convention of Weights and Measures as to the relation between the International and the C.G.S. electrical units, the value of the International Watt Second may be taken as 1.0003 Joules.

ELECTRICAL AND MAGNETIC UNITS

The accompanying table was accepted as defining the units in terms of which the electromagnetic quantities required for practical purposes are measured.

TABLE 1 ELECTROMAGNETIC UNITS

Quantity designated	C G S units			Practical units in terms of	
	Symbol	Defining equation	Name	C G S units	Volt-ampere units
Flux	Φ	$\frac{d\Phi}{dt} = -E$	Maxwell	10^8 Maxwells	Volt second
Magnetic Induction or Flux Density	B	$\int B\,dS = \Phi$	Gauss	10^4 Gauss	Volt second per cm ^{2}
Magnetomotive Force round a circuit	F	$F = 4\pi NI$	Gilbert = Oersted cm	10^{-1} Gilbert	$1/4\pi$ ampere turn
Intensity of Magnetising Field	H	$\int H \cos \theta\, dl = F = 4\pi NI$	Oersted	10^{-1} Oersted	$1/4\pi$ ampere turn per cm of path of H
Permeability	μ	$\mu = \frac{B}{H}$	Permeability[*]	$\frac{10^4 \text{ Gauss}}{10^{-1} \text{ Oersted}}$	$\frac{\text{Volt second per cm}^2}{1/4\pi \text{ ampere-turn per cm length of path of } H}$

In the report mention is made of the decisions of the International Electrotechnical Commission at its meeting in Paris in 1933, one of which was the statement that the formula $B = \mu_0 H$ represents the modern concepts of the physical relations for magnetic conditions *in vacuo*, it being understood that in this expression μ_0, the permeability of free space, possesses physical dimensions

In the case of magnetic substances, the above formula becomes $B = \mu_1 H$, in which μ_1 has the same dimensions as μ_0. It follows that the specific or relative permeability of a magnetic substance is a number equal to μ_1/μ_0

As a consequence of this, the International Electrical Commission recommended that the symbol μ_0 should be introduced into certain formulæ employing magnetic units

The report also includes a number of appendixes dealing with the basic definitions of the system of electrical units, alternative methods of definition; the resolutions adopted by the International Electrical Commission at Oslo in 1930, and the Giorgi system, in which the metre and the kilogram replace the centimetre and the gram in the system of fundamental units, whilst the ohm is taken as the fourth There is also a supplement by Prof Abraham entitled "Note sur ce que pourraient être les définitions des grandeurs magnétiques", which has been prepared by him in response to a request made at a meeting in Paris in July 1932.

THERMODYNAMIC SYMBOLS

The Commission in its report points out the diversity of practice as regards thermodynamic symbols, and is of the opinion that it is desirable to make an effort to remedy the existing confusion

The following resolutions were accepted by the General Assembly.

(1) That Table II be put forward for the National Committees as a satisfactory series of symbols and nomenclature for the thermodynamic quantities referred to, and

(2) That E, φ and I be accepted as alterna-

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[*] The unit of 'permeability' on the C G S system is the permeability of free space—in practice that of the air This unit has received no special name The statement that the permeability of a given medium is μ implies that it is μ times the permeability of free space

Complete agreement as to the definitions of B and H has not yet been reached For the definition of B we are not far from it, but the definition of H still remains somewhat uncertain If in the future, definitions should be adopted which would imply that B and H are quantities of the same kind, Table 1 would still hold It would then be understood that the names Gauss and Oersted were two different names given to the same quantity determined by experiment In these circumstances either one or the other of the two synonymous words might be employed as found more convenient.

tive symbols for Internal Energy, Entropy and Heat Content respectively.

(3) That thermodynamic quantities should always be expressed in the Centigrade scale of temperature.

TABLE II SYMBOLS FOR THERMODYNAMIC QUANTITIES

Name	Entropy	Internal Energy	Free Energy	Thermal Potential or Gibbs' Function	Heat Content or Enthalpy	Work
Formula	—	—	$U - TS$	$U - TS + PV$	$U + PV$	
Symbol	S or φ	U or E	F	G	H or I	W

In the above formulæ, P and V should be interpreted as representing a generalised force and generalised co-ordinate respectively

FUTURE WORK OF THE COMMISSION

Consideration was given to the policy which should govern the future activities of the Commission and its relationship to those other international bodies which deal, among other matters, with the definitions and nomenclature of their subjects

The International Union of Pure and Applied Physics decided that the S U N Commission might usefully continue to work·

(1) By co-operating with existing international bodies in the preparation of glossaries or lists of definitions with the view of making them more useful to physicists in general

(2) By preparing, for general adoption, lists of terms occurring in two or more branches of physics.

(3) By assisting those who, in any country, are engaged in preparing such lists, with the view of bringing workers in different countries into contact and securing harmony in the results of their work

Copies of the complete report of the Commission will be obtainable from the Physical Society (1 Lowther Gardens, London, S W.7) at a price of 2*s* 9*d* in paper covers and 5*s* bound in cloth

E G

The Eider Duck (*Somateria mollissima mollissima*)

By SETON GORDON

THE eider duck, because of the handsome and striking plumage of the drake, is a familiar object off the coasts of Britain It is more numerous in Scottish than in English waters, but is plentiful throughout the year off the coast of Northumbria, where the eider is known as St. Cuthbert's duck, because of the tradition in the district that St Cuthbert, who had his cell on one of the Farne Islands, tamed the eiders of old

In Scotland the eider duck is found both east and west, and is particularly numerous during the winter months on the sheltered sea lochs on the east side of the Isle of Skye On the open waters of the Minch it is not really plentiful, nor is it often seen in winter on the open Atlantic west of the Hebrides When the eider is seen at close quarters the striking beauty of both drake and duck is apparent The drake with,his black head, pale sea-green cheeks, and white breast with its faint rosy flush, is a striking object as he courts his more sober-coloured mate, but she, too, is beautiful, for a warm rosy flush is upon the rich brown feathers of her breast and back, and to relieve the monotony of her colouring there are two white bars on her wings.

The late Viscount Grey of Fallodon had an eider drake in his bird sanctuary at Fallodon for twenty-one years, and up to the last the old eider, although he was blind in one eye, delighted in courting the mallard ducks on the pond, and their rightful mates, aware that the old fellow's intentions were harmless, watched him with amused tolerance

In very early spring, sometimes even in winter, the eider drake can be seen courting the duck that has attracted his fancy Swimming round her, he raises himself on the water and utters soft cooing notes It is indeed possible that the eider remains paired throughout the year, and the late Viscount Grey told me that on seeing a large flock of eiders off the coast of Northumberland one winter day he carefully counted the sexes in the flock, and found that ducks and drakes were present in exactly equal numbers

It is a characteristic of drakes which have an 'eclipse' plumage that they take no part in the rearing of the brood, and the British eider drake is never seen near the nest In this characteristic he is different from the eider of Spitsbergen, which nests in colonies I visited some of these Spitsbergen colonies in the summer of 1921, and found the drakes on the island with the ducks, and in some instances standing guard while the ducks brooded their eggs. The drakes may have kept off the Arctic skuas which were present at most of these colonies of eiders, ready to swoop down and suck the eggs of any unprotected nest Sometimes when an eider duck left her nest, after having covered it carefully with the down which lined it, she apparently thought that her eggs would be safe from the, marauding skua gulls, but the skua on flying up, with a few swift and deft movements of the bill, exposed the eggs and made a rapid meal of them.

Sealing sloops make the journey each summer from northern Norway to Spitsbergen to gather eggs and down of the eider duck. The down is used for quilts, and the eggs are sold in the northern towns and villages of Norway, where the domestic hen (perhaps because of the difficulty of feeding it through the long Arctic winter) is rarely seen.

The eider duck is an assiduous diver, and most of its food is taken from the floor of the ocean. It is particularly fond of mussels, and the fishermen of the north-east coast have tamed eider ducks in a remarkable manner by feeding them on the mussel bait that is wasted when a sudden change of weather with rough seas, occurring after the mussels have been shelled, prevents the lines being baited with them. The eider duck feeds also upon limpets, periwinkles and razor-shells, and has been known to swallow razor-shells up to ten inches long. Small crabs, sea-urchins and star-fish are also eaten. Eider ducks are expert divers, but they do not like a rough sea, and are not happy in turbulent breaking waves where scoter and scaup are often seen swimming and diving. Eiders, both ducks and drakes, often land on some low skerry on a falling tide, and stand contentedly, dozing or preening their feathers, but the eider duck very rarely ventures above high tide-mark except during the nesting season.

I do not remember having seen an eider drake at any distance from the tide except on one occasion. This was early on a May morning, in the Isle of Skye. I was motoring along the main road between Portree and Kyleakin, and where the road skirts Loch Ainort and winds along the hill-face at a height of perhaps one hundred feet above the sea, I saw on the road what at a distance I thought was a seagull. But as I approached I saw that this was no gull, but an eider drake, and as the car neared him he flew out over the heather-covered hillside and then out over the sea. He may have been accompanying his duck in a search for a suitable nesting place, but if the duck was in the neighbourhood she did not appear, nor did she fly away with the drake.

The eider lays four to six large unspotted eggs of a greenish colour, and when she is suddenly disturbed from them she fouls her nest as she flies off, presumably to render the eggs less attractive for an animal which might otherwise make a meal off them. The ducklings take to the sea on the day they are hatched, and are able to swim and dive actively. They are excellent divers even from their earliest youth, and are able to survive and even to enjoy breaking waves, diving through them and keeping pace with the mother without difficulty. But a prolonged period of rough and cold weather soon after they are hatched is fatal to the weaker members of the broods, and a mother eider duck may often be seen with only a single duckling following her. The young ducklings have many enemies, and perhaps the most ferocious is the greater black-backed gull, which pounces down upon an unattended duckling and swallows it whole.

Obituary

PROF. CHRISTIAN HÜLSEN

WE regret to record the death of Prof. Christian Hulsen, the archæologist, which took place at Florence on January 19 at the age of seventy-six years.

Christian Hulsen was born at Charlottenburg and was educated at the University of Berlin, where he came under the influence of Theodor Mommsen, the Roman historian. From 1882 until 1885 he studied in Italy as a travelling scholar of the Archæological Institute. He returned to Berlin as a schoolmaster, but in 1887 he became a secretary of the German Archæological Institute in Rome, where he remained until his retirement in 1909. He then took up his residence in Florence and devoted the remainder of his life to writing and research.

Hülsen's main life-work as an archæologist lay in the two departments of epigraphy and topography. As an authority on the Rome of the classical, medieval and Renaissance periods he was without a rival, with the exception of the late Prof. Lanciani. His book on the Forum and its excavation by the Com. Boni achieved a wide popularity, while for more serious students his account of the excavations on that site and on the Palatine, published in 1928, is a standard of reference. Of an even more authoritative character is his "Formæ Urbis Romæ antiquæ", which is especially of value to the student for its plans of the ancient city, and its index and bibliography of the monuments. In the study of medieval and Renaissance Rome, his outstanding contributions were the publication of the Barberini codex of Giuliano de Sangallo and of the Berlin drawings of Marten van Heemskerch, the latter in collaboration with Hermann Egger. His "The Churches of Rome in the Middle Ages" is a mine of valuable detailed information.

In epigraphy Hulsen's immense fund of knowledge of Roman topography served him well in compiling the inscriptions of the city of Rome for the "Corpus Inscriptionum Latinarum". In addition to his other work which appeared in book form, he was the author of a large number of contributions to archæological periodical publications in both Italian and German.

Hulsen was an honorary D Litt of the University of Oxford and of Columbia University, New York, where he had delivered a course of lectures In 1917 he was appointed honorary professor in the University of Heidelberg, and shortly before his death he was informed of his election to be one of the nine honorary members of the Pontifical Academy of Arts and Archæology, Rome

MR JOHN FRASER

JOHN FRASER was born on January 31, 1854, at Newdeen, Fraserburgh, Aberdeenshire, and died in Charing Cross Hospital on January 24, 1935, from pneumonia following injuries received in a road accident

Mr Fraser was well known both as a horticulturist of high repute and as a critical student of the British flora In horticulture he received training at the old Chiswick gardens of the Royal Horticultural Society and at Kew In May 1885 he commenced work in the Jodrell Laboratory, Kew, for Sir John Lubbock, afterwards Lord Avebury, and the connexion thus established lasted for many years Fraser was responsible for much of the detailed work underlying Lord Avebury's classical researches on seedlings, pollen, buds, stipules and other botanical subjects He also edited or contributed to many well-known horticultural publications

As a field collector and observer and a herbarium investigator, Fraser was held in high esteem by a wide circle of botanical friends In his later years he specialised on the taxonomically difficult genera *Mentha* and *Salix*, and his published accounts of those genera give evidence of a clear logical mind and considerable ability in concise description His fine herbarium collections of about nine thousand sheets, together with his manuscript notebooks, have been presented, at his written desire, to the Royal Botanic Gardens, Kew, by members of his family There are many valuable Scottish gatherings among his specimens, and the flora of Surrey is particularly well represented His collection of seedlings of British plants, numbering several hundred sheets, must be unique, and will be of great value in future investigations of life-histories

Fraser was elected a fellow of the Linnean Society in 1889, and the Council of the Royal Horticultural Society conferred on him the Victoria Medal of Horticulture in 1922 and the Veitch Memorial Medal in 1929 W B TURRILL

WE regret to announce the following deaths

Mr Eric H S Bruce, editor of the *Aeronautical Journal* in 1899 1908, well known for his work in aviation, especially on balloons, kites and airships, on February 28, aged eighty years

Prof William Duane, professor of biophysics in Harvard University since 1917, an authority on radioactivity and X-rays and their application to the treatment of disease, aged sixty-three years

Mr W J A Grant, a member of several Arctic expeditions, after whom Cape Grant in Alexandra Land was named, on March 10, aged eighty-three years

News and Views

A British Magnetic Survey Vessel

THE explanatory statement by the First Lord of the Admiralty, which was presented with the Navy Estimates for 1935 to the House of Commons on March 6, contained the interesting information that it has been decided to construct a magnetic survey vessel A first instalment of £10,023 towards the construction of this vessel has been included in this year's estimates The unfortunate destruction by explosion and fire of the *Carnegie* on November 29, 1929, while in harbour at Apia, Western Samoa, brought the valuable work which had been carried on by this vessel to a sudden conclusion Constructed for, and maintained by, the Carnegie Institution of Washington, she had in six cruises between 1909 and 1921 traversed 252,702 nautical miles in 3,267 days actually at sea Of the seventh cruise of 110,000 nautical miles, nearly one half had been completed upon the arrival of the *Carnegie* at Apia, this cruise was planned particularly with the view of determining magnetic secular variation

THE magnetic charts published by the British and other Governments for use at sea have been based in recent years to an increasingly large extent upon the data provided by the *Carnegie* There are some serious gaps in the present data, which would have been filled if the *Carnegie* had completed her last cruise Due partly to these gaps and to a recent rapid change in the secular variation in the Indian Ocean, the extrapolated values of the magnetic elements in the southern Indian Ocean are now unreliable, and the possibility of serious errors in this and other areas in future charts has given rise to some concern. The Carnegie Institution, having definitely decided not to replace the *Carnegie*, and in view of the special interest of Great Britain, as the principal maritime nation, in the accuracy of the magnetic charts, the British Government has assumed the responsibility A non-magnetic ship is to be constructed, primarily for the purpose of determining magnetic data at sea Details of the design have not yet been decided upon, though it is probable that the new vessel will be larger than the *Carnegie*

Refugee Scholars

A PAMPHLET entitled "A Crisis in the University World" issued last week by the High Commissioner for Refugees from Germany (obtainable free of charge from the General Secretary, Academic Assistance Council, Rooms of the Royal Society, Burlington House, W 1) gives an account of the assistance to displaced German scholars and men of science during the past two years. Approximately 650 of the university teachers dismissed have left Germany. Of these, 248 have been permanently re-established, 131 in Europe and 117 outside Europe, 366 others have been given temporary assistance which has enabled them to continue their studies in universities or other institutions Most of this work of academic assistance has been carried out by special emergency committees in Europe and the United States, which have succeeded in raising a quarter of a million pounds for the purpose of creating special positions in universities and research centres for the refugee scholars Nearly £69,000 has been specially raised in Great Britain for the assistance of the refugee scholars 40 have been permanently re-established and 170 have been given temporary hospitality In addition, the Academic Assistance Council has been recognised as the international information centre by the High Commission for Refugees The pamphlet outlines the plans of the academic committees for the future, it states that a constructive solution of the problem is possible and that the task undertaken by the committees is manageable, provided that there is sufficient financial support

Academic Assistance Council

A PUBLIC appeal for funds has been made by the Academic Assistance Council to enable it to continue its work The appeal is signed by Mr Stanley Baldwin, Viscount Cecil of Chelwood, Mr Winston Churchill, the Earl of Crawford and Balcarres, the Marquess of Crewe, Viscount Halifax, the Marquess of Londonderry and Lord Meston, in their private capacities as members of the university world and not officially as chancellors of British universities The Council needs funds with which to continue emergency grants in aid to approximately seventy of the displaced German scholars for a period of not more than two years, and also for the creation of twenty special research fellowships of a more permanent character It is essential also that the Council shall be enabled to continue its important work as an information centre and its investigations throughout the world for new positions in which the temporarily assisted scholars may be placed on a self supporting basis The Academic Assistance Council has, from the start, emphasised the issues of principle implicit in its work; it has not confined its activities to the displaced German scholars alone The great importance of the research which the Council has been able to salvage has been demonstrated from time to time during the past two years in our own columns and in those of other scientific journals As a research subsidising organisation, the Council has, indeed, an impressive record and merits continued support. Donations, subscriptions or bequests should be sent to Lord Rutherford, president, Academic Assistance Council, Rooms of the Royal Society, Burlington House, W.1; cheques should be made payable to the Academic Assistance Council.

Col. Crompton's Ninetieth Birthday

THE many friends of Col. R E. B. Crompton, F.R.S., are organising a banquet to be given in his honour on May 31, which will be his ninetieth birthday At this banquet he will be presented with his portrait, and he has signified that his intention is to present it to the Institution of Electrical Engineers Col Crompton has had a wonderful life He still talks about the Great Exhibition in Hyde Park in 1851 as if it were an affair of yesterday At the age of eleven, he enrolled as a cadet in the Royal Navy, and before reaching the age of twelve received the Crimean War medal and Sebastopol clasp In 1864 he was gazetted into the Rifle Brigade, and did much for road transport in India by helping to substitute road engines for bullock trains He began work as an electrical engineer in a small way at Chelmsford in 1878, but in 1881 at the Paris Exhibition he gained the first gold medal ever given for electric lighting plant In 1886 we find him, with the warm approval of the Emperor Francis Joseph, supplying the Opera House in the Ring Street in Vienna with the electric light; and he soon found it necessary to open a branch in Vienna He took a leading part in the South African War, designing traction engines fitted with dynamos and portable searchlights He also saw much active service During the War of 1914-18 he did very valuable work in connexion with 'tanks' He has always had an unflagging interest in motor vehicles and in the adaptation of roads for their use Those who use our highways owe him a deep debt of gratitude He has been a member of the councils of the Institutions of Civil and Electrical Engineers longer than anyone else.

Prof. Norbert Wiener

PROF. NORBERT WIENER, professor of mathematics at the Massachusetts Institute of Technology, has accepted an invitation to join the faculty of the National Tsing Hua University in Peiping, China, as research professor of mathematics for the next academic year. Prof Wiener expects to sail for China next July Dr Wiener's outstanding contributions in the field of higher mathematics have brought him wide recognition Last April he was elected to membership of the U S National Academy of Sciences, and in 1933 he was a joint recipient of the Bocher prize given by the American Mathematical Society for notable work in mathematical analysis He is a member of the London Mathematical Society, and in 1931–32 served as lecturer at the University of Cambridge He has carried on advanced studies at Cornell, Columbia, and the Universities of Cambridge, Göttingen and Copenhagen He joined the staff of the Massachusetts Institute of Technology in 1919 and in 1932 was appointed to full professorship The National Tsing Hua University is maintained by indemnity funds following the Boxer rebellion, which were returned to China for educational purposes by the United States. From time to time the University entertains men eminent in various academic fields as visiting members of its staff Among them have been Prof. George D. Birkhoff of the mathematics department at Harvard, the Indian poet and philosopher, Rabindranath Tagore, Bertrand Russell, the French mathematician, Hadamard, and the French physicist, Langevin

Max Oertel

Max Josef Oertel, one of the most eminent and versatile German physicians of the second half of the nineteenth century, was born at Dillingen in Bavaria on March 20, 1835. He first studied under Prof von Pettenkofer at Munich, where he made a considerable number of analyses of the air in various public institutions and private houses which he published in a work entitled "Experiments on the Accumulation of Carbonic Acid in Inhabited Localities" Afterwards he devoted himself to the study of diseases of the throat, including diphtheria, on which he published some of the most important articles on the causation of the disease prior to the discovery of the Klebs-Loeffler bacillus His other works on diseases of the throat were concerned with tumours of the larynx, instruction in laryngology, and treatment of respiratory affections Oertel was the first physician in South Germany to lecture on laryngology, and was appointed extraordinary professor of laryngology at Munich in 1876, which office he held until his death on July 19, 1897. He was also well known as a general physician and particularly for his treatment of diseases of the heart, in which he paid special attention to diet and exercise.

Award of the Duddell Medal to Dr. W. E. Williams

The council of the Physical Society has awarded the twelfth Duddell Medal to Dr W Ewart Williams, lecturer in physics at King's College, London, who is distinguished for his work in optical design, chiefly in the region of interferometry The Medal is given to "persons who have contributed to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of materials used in their construction". The principal invention of Dr Williams is that of the reflection echelon spectroscope. The basic idea of such an instrument was described by the late Prof Michelson nearly forty years ago, but its practical construction seemed impossible until the discovery by Williams that two optically plane surfaces of quartz or fused silica could be placed in permanent optical contact without exerting the mechanical force needed with glass surfaces He saw that a number of fused silica plates of exactly equal thickness could be built up in the necessary echelon formation without introducing any distortion that would ruin the optical performance of the instrument The reflection echelon is the only form of spectroscope of sufficient resolving power which can be used in the ultra-violet part of the spectrum, where, in a number of cases, lie the lines of greatest interest from the point of view of 'fine structure', a detailed study of which gives us information about the structure of the nucleus in its normal state.

By adding two small mirrors to the echelon and mounting it in an evacuated chamber, Dr. Williams has adapted the instrument, originally meant for fine-structure work only, for the accurate measurement of the wave-lengths of the lines. In consequence of the far greater resolving power now available, the wave-lengths of the lines can be measured with a corresponding greater degree of accuracy, and the method of calculation is far simpler and more rapid than with the Fabry-Perot interferometer He has also devised a method of standardising the metre in terms of wave-lengths by means of the reflection echelon This permits the number of wave-lengths contained in a gauge of approximately a metre length to be determined in two operations, as distinct from the numerous stages involved in the present methods The principle of the reflection grating has been also applied by him to directional aerial systems for short-wave wireless transmitters, which are being used in America, and he has improved a number of optical instruments, amongst which are the Rayleigh refractometer and (in conjunction with Mr. F. Twyman) the Fabry-Perot interferometer.

National Inland Water Survey

In the discussion which followed the reading of Dr Brysson Cunningham's Paper on National Inland Water Survey, a summary of which appears on p. 443 of this issue, Vice-Admiral Sir Percy Douglas, the chairman of the British Association Research Committee on the subject, described the work of the Committee subsequent to the date of the reception of the deputation by the Minister of Health, and expressed the gratification which he felt at the unanimous agreement of the members of the Committee on a draft outline of the scope of the survey which had been drawn up and forwarded to the British Association, and which he hoped would be recorded in the *Geographical Journal*, for which purpose he read the several items Dr H R Mill spoke of the association of the Royal Geographical Society with water survey, and alluded in particular to the observations made on the Exe and the Medway with which he had been connected Sir Henry Lyons, chairman of the new Survey Committee, welcomed the interest taken in the matter, and said that as his Committee had only just met quite recently for the first time, it would be premature at present for him to express any views on the course of action which he and his colleagues might decide to take Capt W. N McClean described the more important features of River Flow Records, and showed how he had built up an organisation which he considered might be of great assistance in the work of river and stream gauging. Mr. G. J. Griffiths, chief engineer of the Thames Conservancy Board, emphasised the value of river flow records and the advantage which had accrued from having prolonged observations at Teddington and elsewhere; he considers a national survey to be long overdue. Dr. Bernard Smith dealt with the importance of observations relating to underground water and the necessity of prosecuting researches thereon in all practicable directions.

Preservation of Sites of Scientific Interest

The British Association has recently been receiving from the Ministry of Health information of all schemes in progress under the Town and Country Planning

Act, in order that if any of these should disclose any risk of the destruction of sites or objects of scientific interest, representations may be made on behalf of the Association to the planning authorities and to the Ministry. In addition to natural features, or possibly buildings, which may be worthy of preservation on scientific grounds alone, it is clear that there must be many areas worthy of protection on grounds of amenity, and at the same time of sufficient scientific interest, whether geological, botanical or otherwise, to justify adducing arguments from the side of science in their favour. The first step taken by the Council of the Association was to communicate with all the local societies in correspondence with the Association, inviting their attention to the subject of planning and asking for information on any instances in which the Association might usefully take action . only a few have as yet come to hand. The whole subject will come under consideration at the Norwich meeting of the Association, when it will be dealt with by Prof P. G H. Boswell in an address as chairman of the Conference of Delegates of Corresponding Societies Meanwhile the Council has appointed a panel of some sixty prominent members representative of geology, geography, botany and zoology, any of whom may be called upon for advice in connexion with proposals for preservation, and all of whom have been asked to bring to the notice of the officers any examples which may have come under their personal notice

Roman Villa near Lydney

A NEW Roman villa on the River Severn near Wollaston, between Lydney and Chepstow, of which the discovery and partial exploration is described in *The Times* of March 8, illustrates the perennial character of the human response to an enduring need A fire-platform and lighthouse in alignment mark the channel through the Guskar Rocks guarding the creek, on which the villa is situated, in a manner which might stand in a modern sailing direction Before the examination of the site the existence of the creek, which had silted up, was indicated only by a stream in a depression ; but evidently it must have been, with Lydney harbour, a port of call of importance, probably in relation to the iron-workings of Ariconium (Weston-under-Penyard) to the north. In any event, the villa with its sea-frontage was not only the centre of a wide settlement, still unexplored, but it is remarkable also for the unusual amount of iron it has yielded among its relics The earlier villa, upon which a second was superimposed, was erected about A D. 130 in the reign of Hadrian. It stood about 250 yards from the shore. It was of considerable size and contained nine rooms and a corridor and had a bath system along the sea front. One hundred and seventy years later it was destroyed, possibly, it is thought, by an Irish raid. After a lapse of twenty years, the second, a smaller building, was erected. It contained only four rooms, but it also had a bath system. This villa lasted for about a century. The details of the buildings and the associated relics have provided a number of noteworthy features, and the further examination of the site, which depends, as usual, upon funds being raised, will undoubtedly well repay the expenditure of time and money

Irish Folk-lore

THE appointment by the Irish Free State of a Commission on Irish folk-lore is an extension of the active interest already shown by the authorities in the antiquities and history of Ireland that will be welcomed by all students of her traditions and ancient culture. The Commission is to be comprehensive in scope It will arrange for the collection, collation and cataloguing of both oral and written folk-lore material, and also, if thought desirable, for the publication of such material The scheme for collection which has been drawn up includes provision for a body of collectors who will travel through the country for the purpose of taking down by means of recording machines not only tales and songs, but also, among the older members of the community, their recollections of life in the country-side in their young days Subject to the approval of Dail Eireann, a sum not exceeding £3,250 a year, for a period of five years, will be devoted to the work of the Commission. Although Ireland, in comparison with other parts of the British Isles, has not been badly served in the matter of attention from the collector of local lore and legends, it has always been known that extensive tracts of tradition and custom remained untouched , and notwithstanding the sophistication which has affected Ireland in common with other countries of recent years, the remoter districts still retain much of their primitive character and tradition In addition to its work of collection, the Commission's activities will afford an opportunity for that systematic treatment of the material for which adequate opportunity has not hitherto been available, but which in dealing with conditions in Ireland is highly desirable

British Museum Acquisitions

AMONG the notes on recent acquisitions by the British Museum in the *British Museum Quarterly*, 9, No. 3, particulars are given of sources from which came part of the sum required to make up the initial payment for the Eumorfopoulos collection of Chinese and Far Eastern art, and progress is reported in the allocation of the collection to Bloomsbury and South Kensington. A contribution of £5,000 was received from the National Art Collections Fund, £5,000 from Sir Percival David and £1,000 from the Universities' China Committee in London. The bequest to the British Museum and the Victoria and Albert Museum of three quarters of the residue of the estate of the late J R. Vallentin for the purchase of works of art for the two museums was also allotted to this use. It is stated that the collection is so large that it will be possible to place a certain number of pieces on loan in some of the leading provincial museums. When, however, the scheme for a Museum of Oriental Art comes into being, it is intended to recall these loans, and the whole collection will be brought together again to form an important part of what, it is hoped, will be the finest museum of oriental art in existence. Parts of the collection already have been, or are in course of being, described, but accounts of special classes of exhibits are to be prepared and published from time to time. Among other notes in this issue of an interesting publication which is not so widely known as it deserves, is an account of the fragments of the unknown gospel acquired last summer, to which Mr. H. L. Bell has recently directed attention in *The Times*, and descriptions with illustrations of an Egyptian wax figure which, if it be, as is thought, a model for making moulds for casting bronze figures, is indeed rare, and some unique objects of a varied nature from Roman London.

Empire Cotton Growing Corporation

AT a meeting of the Administrative Council of the Empire Cotton Growing Corporation held in Manchester on February 7, the resignation was received of Mr. Milligan, who has been the Corporation's senior representative in Africa since 1924. During this time he has travelled constantly about South Africa and visited in addition the Corporation's staff in Swaziland and Rhodesia. He has been succeeded by Mr. Parnell, who has long been associated with the Corporation's work in South Africa. The Council received the report of Mr. May, assistant secretary of the Corporation, upon a tour he had recently made in East and South Africa, particularly with reference to developments in Tanganyika Territory. At many places in this territory, the Corporation's assistance will be used towards developing an interesting scheme, evolved by the Agricultural Department, for native holdings on which cotton will be grown in a system of mixed farming. Each family will be given the freehold of their holding, which will consist of 20 acres. Of these, 10 acres will be reserved for cattle grazing, and the remainder for the dwelling site and land for the cultivation of cotton and other crops. The natives will also be given instruction in the preparation and use of farmyard manure.

THE Mwanza area of Lake Province has hitherto produced about half the cotton grown in Tanganyika. The organisation of its seed supply is therefore a matter of importance, and with the help that is now being given by the Corporation it is hoped to put this on a satisfactory basis. The selection of the best strains will be carried out at the Experiment Station at Ukiriguru; these will then be multiplied in the special area that is being provided for the purpose, just across the arm of Lake Victoria known as Smith Sound. The seed from this area will be bulked on an island in the Lake, which makes an admirable isolated area where admixture of the strains can be prevented. The bulked seed will then be distributed in the following season throughout the Lake Province.

Forest Research in the Malay States

THE annual report of the Forest Research Branch, 1933, is issued with the "Report on Forest Administration for the year 1933 of the Federated Malay States" (a Supplement of the *F.M.S. Government Gazette*, June 15, 1934. F.M.S. Government Press). Research, under which is included education, has made considerable progress in the Forest Department of the Federated Malay States. A Forest School has been started much on the lines of the Rangers' School at Dehra Dun, India, which has nearly half a century of good work behind it. The practical courses of the Malay School during the year under view included a forest reconnaissance in mountainous jungle in the State of Perak; it served the excellent purpose, among others, of acquainting the students with commercial tree forms not normally encountered in the lowland forests. An area of 2,400 acres of this hill forest in the Bubu reserve was explored and the enumeration work was conducted on more intensive lines than hitherto, both as regards composition of the crop and the possibility of commercial exploitation. This appears an excellent departure and the experience thus gained should be invaluable to all, whilst the work achieved will be of practical value. Research work is being carried on in sylviculture, where some interesting research work is being achieved, botanical, wood technology, timber testing, wood preservation and forest economy generally; while zoological, chemical and meteorological problems are being studied.

The National Herbarium at Melbourne

THANKS to the generosity of Sir MacPherson Robertson, a new building has just been completed in Melbourne for the housing of the National Herbarium collections, and the transfer of material is in progress. The building is a block, approximately 100 ft. by 80 ft., containing two floors. On the upper floor provision is made for the collections (numbering some 1,500,000 sheets) and for a library of more than 10,000 volumes. On the lower floor are a museum of economic botany, a laboratory, a lecture hall and the administrative offices. The construction is fire-proof throughout; all cabinets are of steel and the main door is guarded by fire-proof devices operating automatically when the temperature reaches a certain point. The collection was commenced about 1856 by the late Baron von Mueller, and it is intended to preserve the existing division into two sections (i) Australian and (ii) extra-Australian. The former is very complete and contains a number of type specimens. The room allotted to it is 60 ft. by 35 ft., allowing for 30 per cent expansion, or 55 per cent if further cabinets be installed. The extra-Australian section, which is already extensive and is continually growing by exchanges, will be housed in a room 80 ft. by 35 ft.

Sounds made by Fishes in the East Indies

IN NATURE of November 17 (p. 769), we quoted an interesting account of sounds heard in the East Indies by Capt. P. Jansen. We have received a letter from Dr. J. D. F. Hardenberg, of the Laboratory for Investigation of the Sea, Batavia, with reference to this note. He states that the comparison of these noises with the sounds made by foghorns is quite correct. They remind one also of the sounds made by motor traffic on a busy thoroughfare when heard at a distance of about a hundred yards. The noises, however, do not proceed from the earth, but are made by fishes of the genus *Therapon*, as described by Dr. Hardenberg in a recent paper (*Zööl Anz*, **108**, 1934) The other sounds mentioned by Capt Janson have also been heard by Dr Hardenberg, though less frequently, and once, when in the Java Sea, he heard sounds as if made by silver bells Their origin is still unknown, but he supposes that they are also made by animals.

American Society for Testing Materials

IT is a great help to industry to have standard specifications for the materials used in commerce, and to have methods of testing to find out whether the materials offered for sale come up to the standard or not In Great Britain the British Standards Institution (B S I) of 28 Victoria Street, S W 1, publishes standard specifications and gives also the methods of testing These have been passed by committees consisting of engineers, manufacturers, Government officials and all interested in securing raw materials or finished products of the best quality If experience shows that the methods used are ineffective, then the old committee meets again or another committee is formed and it brings out a revised specification In the United States, the American Society for Testing Materials (A S T M) performs similar functions The *Proceedings* of this Society are issued annually, and give reports by committees and the 'tentative' standards adopted Each of the annual volumes contains about 2,000 pages. In the 1934 volume such subjects as vapour lock of petrol, creep tests and data, soil testing methods, rubber raw materials, etc, are discussed Twenty-one of the standards appearing in the 1933 "Book of Standards" have been revised or discontinued. Fourteen of them have been revised, five of them have been replaced by new tentative standards and two have been completely withdrawn The new problems discussed will be found of interest by physicists, and open up new fields of research

Society of Public Analysts

AT the annual general meeting of the Society of Public Analysts held on March 6, Dr Bernard Dyer gave an address embodying his reminiscences of the Society, from its inception to the present day. At the outset of his address, Dr. Dyer pointed out that the occasion was particularly appropriate, since it was the diamond jubilee of the Society, which held its first meeting in February, 1875, when Dr Redwood was elected president Much of the early work of the Society was concerned with food adulteration, which at that time was gross and widespread, although gradually analytical chemistry in general was brought within the scope, and in 1906 this was recognised when the title of the Society was enlarged to include analytical chemists other than public analysts. Several of the earlier presidents were well known as medical officers of health, who had also been appointed public analysts. Dr. Dyer also touched on the history of the Society in connexion with the Institute of Chemistry and the Government Laboratory, and laid stress upon the fact, that in spite of certain coolness and misunderstandings in earlier days, the most cordial relations have for many years existed between the Society and these bodies The following officers were elected for 1935 *President*, Mr John Evans, *Vice-Presidents*, Messrs L H Lampitt, S E Melling, A More, W H Roberts, *Honorary Treasurer*, Mr. E B Hughes, *Honorary Secretary*, Mr. G Roche Lynch

Hydrogen Cooling

THE losses due to air friction when machines are rotating is often an appreciable fraction of the total working losses The losses can be considerably reduced by running the machines in hydrogen As the thermal conductivity of hydrogen is much greater than that of air, the temperature rise of the machine is further reduced and so it can be run at a heavier load and can therefore be rated as a more powerful machine In the *Electrician* of March 1, there is a description of a 30,000 kilovolt ampere synchronous condenser which has been built for the French Midi Railway The outer casing is built up of steel plates bolted together and designed to withstand the force of any internal explosion which might occur owing to a mixture of hydrogen and air The machine is started by a special type of transformer which only takes a quarter of full load current Tests carried out on the machine with hydrogen and air as cooling media show that the heating of the machine with hydrogen cooling was thirty per cent less than when it was run in air

The Murdoch Trust

THERE has been in existence for a number of years a most admirable trust, known as the Murdoch Trust, for the benefit of indigent bachelors and widowers who have done good work for science and have fallen on less prosperous days Few people seem to be aware of the existence of this Trust or of its beneficent purpose, though a modest advertisement occasionally appears, as, for example, in NATURE of March 2, p lxvi, inviting applications for donations or pensions from it We gladly direct attention to the aid thus available to persons who have promoted or helped the advancement of any branch of science and are in need. The Trustees welcome applications from scientific workers eligible for assistance from the funds they have available Particulars can be obtained from Messrs Shepherd and Wedderburn, 16 Charlotte Street, Edinburgh

Ibero-Americana Oceanographical Conference

THE Ibero-Americana Oceanographical Conference was to have met at Madrid in October last, but it was found necessary to alter the date, and the assembly of the delegates was postponed until the latter part of April 1935 As at present arranged, the Conference will hold its meetings partly in Madrid and partly in Malaga Invitations to attend were sent to the Governments of the various North and South American States and to the Governments of those countries having territories in America. It is understood that the Conference will discuss measures for obtaining oceanographical data of all descriptions in the oceans and waters adjoining their coasts, including the study of ocean currents, marine meteorology and fisheries. Having regard to the existence of the International Association of Physical Oceanography of the Sub-Committee for Oceanography of the Pacific Science Congress, however, and of various bodies dealing with marine biology and fisheries, it is doubtful whether the creation of yet another is desirable or can serve a useful purpose The General Secretary is Señor Rafael de Buen, Alcalá, 31, Madrid

New Land Speed Record

Sir Malcolm Campbell set up a new motor speed record on Daytona Beach on March 7, by obtaining a speed of 276 816 miles an hour. The previous record, also set up by Sir Malcolm, on February 22, 1933, was 272 108 miles an hour The figures for the time to cover the measured mile work out as follows first run, 272 727 miles an hour (13 20 seconds), second run, 281 030 miles an hour (12·81 seconds), average speed, 276 816 miles an hour. Sir Malcolm's car, *Bluebird*, was designed by Mr R Railton, and contains a 2,500 horse power Rolls Royce Schneider Trophy engine.

Announcements

Prof. W. N. Haworth, director of the Department of Chemistry, University of Birmingham, was elected a corresponding member of the Bavarian Academy of Sciences on February 16

The Bessemer Gold Medal for 1935 of the Iron and Steel Institute has been awarded to Prof. A M Portevin, director of the Institut de Soudure Autogène, professor at the Ecole Supérieure de Fonderie, and at the Ecole Centrale des Arts et Manufactures, Paris

The D'Arsonval prize has been awarded by the Société française d'électrothérapie et de radiologie to the Belgian physician Dr Etienne Hubert Henrard, for a thesis on "Short Hertzian Waves and their Medical Applications".

Prof H Levy will deliver a lecture on "Science and Social Responsibility" before the Institution of Professional Civil Servants on March 22 in the lecture hall, Royal Society of Arts, John Street, Adelphi, W C 2 The chair will be taken by Mr H T Tizard. Tea will be served at 5 p m and the chair will be taken at 5 30 p m Admission is free and tickets of admission are not required.

The Royal Society of Arts has recently announced the subjects for the Thomas Gray prizes to be offered in 1935. One prize of £100 will be awarded for an "invention, publication, diagram, etc , which is considered to be an advancement in the Science or Practice of Navigation". The other prize will be awarded for the best essay on "Modern Navigational Appliances." Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W C 2

The following appointments have recently been made by the Secretary of State for the Colonies . Mr H. Atkinson, to be deputy Government analyst, Ceylon , Mr. J R. E Hindson, inspector of plants and produce, to be assistant superintendent of agriculture, Gold Coast ; Mr A H Malpas, assistant marine biologist, to be director, Colombo Museum, and marine biologist, Ceylon ; Mr D B Sabiston, deputy superintending produce inspector, to be superintendent of agriculture, Nigeria

At the annual general meeting of the Institute of Metals, held on March 7–8, the following officers were elected for 1935 . *President*, Dr H Moore ; *Vice-Presidents*, Mr. W R Barclay, Dr C H Desch, Dr A. G C Gwyer, Prof D Hanson, Mr H C Lancaster, Mr E L Morcom , *Honorary Treasurer*, Mr John Fry

The Royal Astronomical Society is prepared to issue (provided sufficient support is forthcoming) a third edition of the Franklin-Adams Chart of the Sky, in 206 sheets, each covering an area 15° × 15° The Chart is in three sections (1) North Pole to Dec + 22°, (2) Dec + 22° to − 22°, (3) Dec − 22° to South Pole The price of the complete set, in three cases, has been fixed at £27, including carriage. Should any desire one or two of the sections only, subscriptions will be received for the part required at a corresponding rate Further particulars, and application forms, may be obtained from the Assistant Secretary, Royal Astronomical Society, Burlington House, London, W.1.

Applications are invited for the following appointments, on or before the dates mentioned .—A temporary assistant engineer in the Headquarters Offices of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S W 1 (March 18) A lecturer (woman) in biology and nature study in the Saffron Walden Training College, Essex—The Principal (March 22). A lecturer in physiology, an assistant lecturer in mathematics, and an assistant lecturer and demonstrator in housecraft at Brighton Technical College—The Secretary, Brighton Education Committee, 54 Old Steine, Brighton, 1 (March 29) A lecturer (woman) in biology and natural history in the Diocesan Training College, Derby—The Secretary (April 1). A professor of physiology in the King Edward VII College of Medicine, Singapore—The Director of Recruitment, Colonial Service, 2 Richmond Terrace, Whitehall, London, S.W 1 (April 8) Two lecturers in mechanical engineering at the Lester Technical Institute, Shanghai—The Lester Trust, c/o Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, E.C 1 (April 8) A chief mining engineer for the Northern India Salt Revenue Department—The High Commissioner for India, General Department, India House, Aldwych, W.C 2 (April 10) Assistant keepers in zoology, entomology, geology, mineralogy, and botany in the British Museum (Natural History), London, S W 7—The Secretary (May 31).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 437.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Period of Radionitrogen

IN their first communication on induced radioactivity, Curie and Joliot[1] reported that a radioactive isotope of nitrogen was formed from boron by bombardment with α-rays according to the scheme:

$${}_5B^{10} + {}_2He^4 \rightarrow {}_7N^{13} + {}_0n^1.$$

The period was about 14 minutes and they carried out chemical tests which helped to identify the radioactive body. We[2] also investigated this reaction and found a period of about 14 minutes. It was shown by Cockcroft, Gilbert and Walton[3] that this isotope of nitrogen could be formed from carbon by bombardment with either protons or deutons, but that the period in this case was about 11 minutes. This latter result has been confirmed by several observers. If this difference in the periods could be maintained, it would suggest a number of interesting possibilities. It has, for example, been used as an argument in favour of the existence of the negative proton.

The chief uncertainty in our former experiments was that, as the activation was carried out in air, we always obtained in addition radiofluorine formed from nitrogen

$${}_7N^{14} + {}_2He^4 \rightarrow {}_9F^{17} + {}_0n^1.$$

Radiofluorine has a period of about 1 minute, and about half of the initial activity of the 'boron source' was due to radiofluorine. It was therefore impossible to start measurements on the radionitrogen until 6–10 minutes had elapsed, and, as the total effect was always small, it was of little use to extend the measurements over more than 30 minutes.

The new experiments have been done under improved conditions, yielding larger counts, and the occurrence of radiofluorine has been almost completely suppressed by activating *in vacuo*. As a result, we could now start counting 2 minutes after the removal of the boron from the source of α-rays and continue the counting for more than an hour. We have counted 16,660 particles in all in seven such experiments and the periods obtained are:

Number of Particles	Period in minutes.	Mean square error
1817	10·4	0·4
1619	11·5	0·5
1378	10·8	0·5
5220	11·3	0·2
3124	11·1	0·2
1980	10·8	0·3
1524	11·1	0·4

The final value for the period obtained by combining all the measurements is 11·0 minutes, with a mean square error of 0·1 minutes. This value is the same, within the limits of error, as that obtained for the period of ${}_7N^{13}$ formed from carbon, namely, 11·0 ± 1 minutes, and it seems therefore that the bodies are identical.

While we plotted the decay of the activity in the usual way, to verify that it was exponential, the above values were obtained by a computation from the observed counts in successive intervals of time according to a method developed by Dr. Peierls. This method is considerably more dependable than the ordinary rough graphical one, since it takes into proper account and uses the fact that the measurements are subject to probability fluctuations. With the graphical method it is impossible to determine the probable error, and there may be a tendency to average the positive and negative fluctuations occurring close to each other in time, instead of striking the proper average over the whole time of measurement.

We have also carried out a rough analysis of the particles, as regards sign of charge, by means of a magnetic field, and have found no evidence of any negative emission from activated boron. The results with positive and negative magnetic fields were much the same as when using activated aluminium (radiophosphorus), or, though in the reverse sense, using a very weak source of thorium C. It is at present uncertain to what extent the reaction,

$${}_5B^{11} + {}_2He^4 \rightarrow {}_6C^{14} + {}_1H^1$$

occurs. The above result is compatible either with a small yield from this reaction or a small mass difference between C^{14} and N^{14}.

We are very grateful to Dr. Peierls for supplying us with full details of his method of calculating the periods.

C. D. ELLIS
W. J. HENDERSON

Cavendish Laboratory,
Cambridge.
March 1.

[1] NATURE, 133, 201; 1934.
[2] NATURE, 133, 530; 1934.
[3] NATURE, 133, 328; 1934.

Do Whales Descend to Great Depths?

WITH reference to the letter of Mr. R. W. Gray in NATURE of January 5, p. 34, the depth to which whales may descend when diving has long been the subject of speculation.

The theory that whales reach great depths is based upon observations made by whalers and others upon the length of harpoon line carried out and its apparent behaviour at the surface. It is also based upon the duration of the dive, long submergence having been frequently taken to imply great depth of descent. The discovery of carcasses of whales at great depths entangled in submarine cables, and stories of a similar nature, have also contributed to this theory. These are in no case reliable as evidence, since there is no possible means of knowing how the carcasses reached the positions in which they were said to have been found.

Apart from the fact that the length of harpoon line carried out and the apparent behaviour of the line at the surface are somewhat doubtful guides to the movements of the whale at the end of it, the greatest caution must be exercised in deducing the normal life habits of a whale from its behaviour on being struck by a harpoon. It is probable that the whale reacts in an abnormal manner to so violent a stimulus, making, perhaps, a plunge into depths far beyond its safety limit. That this does happen seems to be indicated by the fact, mentioned by Mr. Gray, that whales have been known to die beneath the surface after taking such a plunge and have had to be hauled up, occasionally, it is said, with a broken jaw bone.

It is the depth to which a whale may normally descend during the ordinary course of its existence which is alone of interest in the present discussion, and it is doubtful whether evidence with regard to this will ever be obtainable. Those who hold that whales do not, in fact, normally descend to very great depths base their opinion on two, possibly three, considerations.

(1) It is uncertain what the effect of hydrostatic pressure would be upon an animal like a whale diving with its lungs closed. All the organs, the lungs among them, will be compressed. Some protection may be afforded to the lungs by the ribs, but it is still not far wrong to say that the lungs will be compressed to one half their normal volume at 2 atmos. pressure, to one third at 3 atmos., absolute pressure, and so on. Thus, quoting the smallest figures cited by Mr. Gray, if a whale which carries out 200 fathoms of harpoon line were actually to dive to that depth, its lungs would be compressed to considerably less than 1/35 of their normal volume. (Absolute pressure increases by 1 atmos. every 33 ft. of descent.) It seems impossible that the animal could survive anything approaching this compression.

(2) No mechanism has yet been discovered by means of which whales could avoid 'caisson' sickness on returning swiftly to the surface from great depths. The 'retia mirabilia' with which all Cetacea are provided do not seem to have any connexion with this, since they are present in seals and porpoises, which inhabit shallow waters, but can remain submerged for long periods. Their function would seem to be concerned rather with the time of submergence than with its depth.

It is possible that the great whales, owing to the high contractility of the alveolar walls and the slower circulation rate common to all large animals, are less susceptible than other mammals to 'caisson' sickness. The ductus arteriosus also remains open throughout life and may shunt off part of the pulmonary circulation. But if the physiology of the whale is in any way comparable with that of other mammals, the depth to which the animal may descend without incurring the risk of 'caisson' sickness on returning to the surface will not be enormously greater than that to which a man may descend. The safety limit for a man lies at a depth of 7 fathoms. It is possible that the safety limit for a whale might be at twice, three times or four times, even five times, the depth of that for a man, but highly improbable that it would be at 28½ times (200 fathoms) that depth.

(3) Rorqual whales in the south feed on 'krill', *Euphausia superba*. This crustacean forms dense swarms, on which the whales feed, at the surface, and is very seldom taken in quantity in plankton nets below 200 m., while the large majority are taken above 100 m. Thus there seems to be no special need for the rorqual whales, at any rate, to descend much below 100 m. during the normal course of their lives.

Sperm whales feed on cuttlefish. There is no evidence as to the depth at which these cuttlefish live. They have never been taken in nets or trawls and it has therefore been assumed, without justification, that they live at great depths.

F. D. OMMANNEY

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Feb. 18.

Anomalous Scattering and Structure of Light Nuclei

THE method of analysing the anomalous scattering which has recently been developed by Wenzel[1] leads to a more detailed interpretation of the scattering phenomena, and furnishes results which so far are in excellent agreement with the other evidence available for the energy level system for light nuclei.

In Fig. 1 the lowest energy levels for a simplified nuclear model are given. The 'normal' sequence of these terms is represented by 1*s*, 1*p*, 1*d*, 2*s*, 1*f*, 2*p*, 2*d*, 3*s* . . . etc.

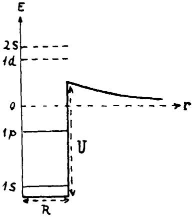

FIG. 1

The dotted levels in Fig. 1 are unstable (virtual energy levels) in the special case for which Fig. 1 has been drawn. We notice that if we deepen our potential hole *U*, more and more of the indicated levels become consecutively stable, and vice versa. Under the actual conditions the virtual energy levels of small positive energy determine the character of the anomalous scattering (resonance scattering).

The analysis of Pose's experiments on the collision of α-particles with protons[2] shows that the scattering is mainly due to a resonance with the virtual 1*p*-level of the proton in the field of an α-particle, and thus will be described as a $1p_p$-scattering (the index *p* referring to a proton level).

This is in agreement with what we know about the α-particle. The $1s_p$-level is stable and occupied by two protons and two neutrons. The next level, however, is already unstable and no Li^5- and probably no He^5-nucleus is likely to exist.

If we increase the weight of the nuclei, the depth *U* of the potential hole is increased. Thus we must expect that in higher nuclei successively, $1d_p$-, $2s_p$- . . . etc. scattering will occur. No other experiments, however, are available at present for proton scattering.

Very similar behaviour is to be expected for neutron scattering.

If we use the model of Fig. 1 to build up the lighter nuclei (up to A^{36}) from protons and neutrons, we obtain exactly the scheme proposed by Bartlett We notice, however, that for many processes this scheme has to be replaced by others which are more adequate If we deal, for example, with α-particles, it is more convenient to speak about α particle levels in the nucleus

Considering the anomalous scattering of α-particles, a similar picture to that of Fig 1 must hold (but we have naturally to account for the Bose-statistics of these particles) We give here the analysis of the anomalous α-scattering by light nuclei ·

$\alpha \rightarrow \alpha$ $1s_\alpha$-scattering[3]
$\alpha \rightarrow Be^9$ $1p_\alpha$-scattering[4]
$\alpha \rightarrow B^{10,11}$ $1p_\alpha$ scattering[4]
$\alpha \rightarrow C^{12}$ $1p_\alpha$-scattering[4]
$\alpha \rightarrow F^{19}$ $1d_\alpha$-resonance disintegration (?)[5]
$\alpha \rightarrow Al^{27}$ $1d_\alpha$ resonance disintegration (?)[6]
$2s_\alpha$-scattering[7]

It is easily seen that this analysis of the anomalous scattering is consistent with all our knowledge about nuclear energy levels

A more complete report on this problem is to be published in the *Physical Review*

G BECK
L H HORSLEY

Department of Physics,
University of Kansas
Dec 31

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[1] *Z Phys*, **90**, 754, 1934
[2] Pose and Diebner, *Z Phys*, **90**, 773, 1934
[3] Rutherford and Chadwick, *Phil Mag*, **4**, 605, 1927 Taylor (*Proc Roy Soc*, A, **134**, 103, 1931) accounts for this scattering by a $2s_\alpha$—scattering The $1s_\alpha$—scattering accounts equally well for the experiments, and avoids all the difficulties discussed by Taylor
[4] Rietzler, *Proc Roy Soc*, A, **134**, 154, 1931
[5] Pose, *Z Phys*, **72**, 528, 1931
[6] Pose, *Z Phys*, **64**, 1, 1930
[7] Rietzler, loc cit

The Phenomenon of 'Wings' and the Vibrational Raman Effect in Benzene and Naphthalene Crystals

As has been pointed out in our previous note[1], the continuous spectrum (wings) observed around the primary line at the scattering of light by liquids consists of two parts The central part just near the primary line (c. 20 cm $^{-1}$ in diphenyl ether) gains in intensity when the liquid is heated, whereas the outer part remains unaltered By comparison of the Raman effect in liquid and crystalline diphenyl ether, we have shown that the later part is not due to the rotation of molecules in the liquids as usually accepted, but is produced by the vibrational Raman lines caused by slow vibrations (probably characteristic for the crystal lattice of diphenyl ether). It seemed to us of interest to include in our experiments also the crystal of benzene because the phenomenon of wings of this substance in the liquid state has been carefully studied by many observers[2].

We investigated the Raman effect of single crystals of benzene and naphthalene. The experiments have fully confirmed our previous results obtained with diphenyl ether. In place of the wings observed in liquid benzene and naphthalene, we have obtained very distinct vibrational Raman lines : $\nu_1 = 63$ cm.$^{-1}$ and $\nu_2 = 108$ cm.$^{-1}$ in the benzene crystal and $\nu_1 = 20$ cm.$^{-1}$, $\nu_2 = 38$ cm.$^{-1}$ and $\nu_3 = 94$ cm.$^{-1}$ in the naphthalene crystal The new Raman lines are indicated by arrows in Fig 1 The spectrogram showing the wings of liquid naphthalene is not reproduced, because it is similar to that of liquid benzene

The central part of the continuous spectrum just near the primary line is of great intensity in the case of liquid naphthalene, and is probably connected with existence of a very large coefficient of depolarisation of the scattered light in this substance We wish especially to emphasise that this part of the wings, the intensity of which increases on heating, is absent in the spectra of crystals (and, as it seems, in amorphous solids) and is apparently characteristic of the liquid state

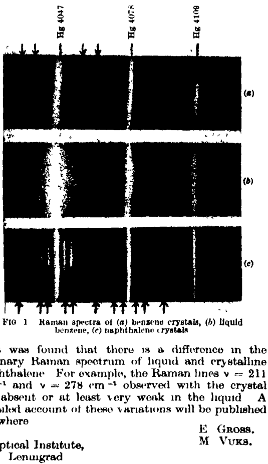

FIG 1 Raman spectra of (a) benzene crystals, (b) liquid benzene, (c) naphthalene crystals

It was found that there is a difference in the ordinary Raman spectrum of liquid and crystalline naphthalene For example, the Raman lines ν = 211 cm $^{-1}$ and ν = 278 cm $^{-1}$ observed with the crystal are absent or at least very weak in the liquid A detailed account of these variations will be published elsewhere

E GROSS.
M VUKS.

Optical Institute,
Leningrad
Jan 2

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[1] NATURE, **135**, 100, Jan 19, 1935
[2] C V Raman and K S Krishnan, NATURE, **122**, 278, 882, 1928 *Proc Roy Soc*, A, **122**, 23, 1929 J Cabannes and P Daure, *C R*, **186**, 1533, 1928 W Gerlach, *Ann Phys*, 1, 301, 1929 I Weiler, *Z. Phys*, **68**, 782, 1931 A Rousset, *J Phys et le Rad*, **3**, 555, 1932 S P Ranganadham, *Ind J Phys*, 7, 353, 1932 S Bhagavantam, *Ind J Phys*, 8, 197, 1933 S Bhagavantam and A V Rao, *Ind J Phys*, **8**, 437, 1934

A High-Pressure Wilson Cloud Chamber

FOR various investigations, such as for large range radiation or when ionisation occurs infrequently, it is an advantage to use high pressure in a Wilson cloud chamber[1]. We have developed a Wilson chamber of 2 cm diameter in which pressure can be increased to 100 atmospheres The desired compression and sudden expansion was obtained by a piston which followed the pressure of gas in a cylinder below the cloud chamber. By this means, a sudden expansion in the cloud chamber was more easily obtained than by the usual mechanical means of moving a piston.

At 80 atmospheres of nitrogen saturated with water vapour, the practicability of a high-pressure Wilson chamber was confirmed. We found that for an expansion ratio of only about 17 per cent, condensation occurred in an ionised atmosphere (radioactive material was brought near the chamber), for a greater expansion ratio a general cloud was always present, and for a smaller expansion ratio no visible condensation occurred even in the presence of strongly ionising substances.

We are now constructing a Wilson chamber of 8 cm. diameter to continue investigations which were suggested by the satisfactory preliminary results obtained with the apparatus just described.

P. KIPFER.

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de l'Université Libre,
Brussels.
Feb. 18.

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[1] Mott-Smith, L. M., *Rev. Sci. Instr.*, 5, 346, 1934, and Brubaker, W. M., and Bonner, T. W., *Phys. Rev.*, 47, 225, 1935. Description of a high pressure Wilson chamber in which pressure can be increased to 20 atmospheres.

Plea for the Preservation of a Scientific Library

THE object of this letter is to avert the threatened dispersal of a unique scientific library with historic associations.

Stephen Peter Rigaud, the most eminent historian of British science of his day and professor of experimental philosophy at Oxford from 1810 until 1839, formed a valuable working collection of books on physics, mathematics and astronomy, of which he made great use during the last decade of his life, when, as Savilian professor of astronomy, he was engaged on his great "Works and Correspondence of Dr. Bradley", 1831, and the much quoted "Correspondence of Scientific Men of the Seventeenth Century", published posthumously in 1841.

Rigaud's library is not only of unique value for the history of a third of the nineteenth century and of the first Radcliffe Observers, but it also includes earlier works as well. That this collection, even at considerable cost, should be kept together in its entirety for the benefit of future students, is the view of Exeter College of which Rigaud was a fellow, and was the view of those Radcliffe Trustees who purchased the collection for historical purposes about the time when the Duke of Marlborough, Sir W. Heathcote, Mr. W. E. Gladstone and Mr. Peel, Speaker of the House of Commons, were managers of that trust for charitable purposes. Also, but a few months back, it was the view taken by the late trustees, Lord Chelmsford and Lord Grey of Fallodon.

The solicitor now writes that the present trustees are contemplating a sale by auction. They have, it is true, given a first choice of books to the Bodleian Library and a selection of pamphlets to the Lewis Evans Collection. But the elimination of the remainder will seriously detract from the scientific value of these portions.

Such a dispersal is believed not to have been their original intention. Before the death of Prof. H. H. Turner it was, I believe, arranged that the entire collection would go to the Savilian professor; and quite recently an offer of the un-donated part of the collection, including many appropriate books on instruments, was made to the Lewis Evans Collection on the condition that the Bodleian should agree to place its recently acquired Rigaud books so as to restore the integrity of the whole library. This, however, the Bodleian found impracticable.

There is now a need for these books in Oxford as never before. The gift of the instruments of the Radcliffe Observatory to the new Museum for the History of Science is only half a gift, if the instruments are unaccompanied by the books of those who used them. The collection of Rigaud pamphlets in the Lewis Evans Collection cannot be adequately dealt with, without contemporary books of reference of their collector. The need of books of historical interest is urgent.

Soon after 1860, when the University Museum of Science was first founded, the Trustees transferred their general library there, to the great and lasting benefit of the University. Now that the University has founded a Museum of the History of Science for ordinary study and historic research, will not the Radcliffe Trustees reaffirm their original policy by adding books to the instruments, pamphlets and manuscripts of Hornsby and Rigaud with which they have endowed the new institution?

Even at this eleventh hour it cannot be too late for the Trustees thus to signalise the worth of their own Observers, and by conserving the whole of the Rigaud library, to earn the gratitude of future historians by giving instead of depriving them of the opportunity of doing for Hornsby, Rigaud and others, what Rigaud with his private library did for Hariot, Bradley and Newton.

R. T. GUNTHER.

Museum of the History of Science,
Oxford.
Feb. 27.

The Concept of Time in Physics

IT would be in the highest degree ungrateful for me to cavil at Prof. Dingle's review of "The Serial Universe" in NATURE of February 9, and I have no intention of so doing. But his criticism of the immortality discussion—a criticism which has been made also by Prof. Stocks and Prof. Joad—arouses in me an uneasy feeling that the book has failed here to emphasise properly the salient points of the argument.

In all questions of continuity, the onus falls, of course, upon the contestant who asserts a boundary. The prisoner is presumed innocent until he has been proved guilty. That, indeed, is the only hope of observer 1, who is in the dock—on the circumstantial evidence of psychoneural parallelism and is pleading for the benefit of any vestige of doubt that may remain. But observer 2 is in a superior position. He is not even accused. He stands beyond the range of the old indictment.

The comment which has been made now is that observer 2, though unaffected by the death of observer 1, may, later on in his own time, encounter some death of a higher-order description. But here the law of the regress must hold. Observer 3, in his turn, would be unaffected by the death of observer 2. Thus, the receding ultimate observer must elude always any kind of death that science will permit us to bring into the picture.

The only escape from this would be to prove that there is a death 2 which, necessarily, *accompanies* death 1—to prove that the observer must die when his instrument breaks. That is what I have sought for throughout the last nine years, and cannot find. Apparently, such simultaneous (in absolute time) destruction of all the infinite series of observers would demand a miracle.

Similar considerations apply in the question of free-will. We may construct, at any stage of the regress, a picture which will include both subject and object; and, in that picture, determinism will reign supreme. But the ultimate observer (who is, incidentally, the draughtsman) remains outside the world thus pictured, and with power to intervene. Prof. Stocks urges that this is merely an infinite series of evasions of the question. Yet, surely, it is clear that what is evaded is not the question, but the determinist verdict. The ultimate observer is not the slave of any constraint that his science can picture.

When no death can overtake you, and no objective circumstance can compel your choice: that is immortality, and that is free-will. But the really interesting thing is that, when those intuitive claims of our consciousness are recognised in that serial fashion which is the essential foundation ('nominalist' or otherwise) of the time picture, then—and not until then—does the world of physics become rational.

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Feb. 15.

I THOUGHT Mr. Dunne's demonstration that time as it is used in physics, is a mathematical device which is justified because, and to the extent that, it is adapted to the interpretation of experience, one of the most valuable parts of his book. It seems to me inadmissible to deduce qualities of experience from the character of a device voluntarily adopted to interpret it. Experience is not at the command of the arbitrary machinery of logic.

This seems to me almost axiomatic, but it might not be superfluous to go from the general to this particular case. If time is regarded merely as an indefinitely extended continuum—as in much physical work it is—it is not suitable for the complete correlation of our experience, because the fact that we necessarily move along it in a single direction is omitted. We must therefore supplement this conception (T_1) by the addition of such a movement, thereby introducing T_2. T_2 thus earns recognition only because it repairs the inadequacies of T_1. As Mr. Dunne admirably shows (pp. 35–36), it was not inherently necessary to start with an inadequate conception. We can describe a fraction as 1/3 or as $0\cdot\dot{3}$, but if we adopt the second form it is necessary to continue beyond the first decimal place; and, in the matter of time, field physics has not done so. But to jump from that to the *independent* significance, of T_2, in which the observing experiencing individual may survive after he has ceased to be in T_1, is logically impossible. One-third is insufficiently represented by 0·3, but it is still worse to call it 0·03.

If one has to say 'yes' or 'no' to the survival question, I agree with Mr. Dunne that the onus of proof is on those who say 'no', but in science, unlike English law, 'Not Proven' is a possible, and often the only possible, verdict. I think it is so here.

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Feb. 19.

Spectrum of Nova Herculis, 1934

THE emergence of a displaced *B* type absorption spectrum at the end of February, coupled with a drop in brightness to 3·5^m–4·0^m, suggests that, after a most unusual life-history of two months, the nova is now developing along more normal lines. Accompanying the O II and N II absorption lines—displaced with a velocity of about − 900 km./sec.—there is to be seen an undisplaced bright band of [N II] at 5755·56. This can be traced back on the spectrograms to January 22.

We should like to correct our previous statement[1] that the forbidden lines of O I at 5577, 6300, 6363 A. had not previously been found in novæ. Dr. W. H. Wright observed the lines in Nova Ophiuchi, 1919[2], but the lines could not then be identified as [O I]. It is of interest to note that, while in the aurora and the night sky spectra, 5577 is the strongest line and in the nebulæ it is too weak to be observed, it is found in the nova of varying strength, but frequently about the same strength as 6363.

A. BEER
F. J. M. STRATTON

Solar Physics Observatory,
Cambridge University.
March 5.

[1] NATURE, **135**, 346; 1935.
[2] *Pub. of the Lick Obs.*, **14**, 12; 1920.

A Blue Flame in the System N_2O_5/O_3

WHEN dry nitric anhydride is vaporised in a stream of ozonised oxygen, and then passed through a glass tube heated by a small flame, the colourless gas becomes brown, through the formation of nitrogen dioxide, a short distance before the flame is reached. A narrow zone of a dark grey-blue colour is, however, seen hovering at the boundary, and this is preceded by a zone of clear blue. In a long tube, the blue flame thus formed 'strikes back' from time to time, at the rate of about 10 cm. per second, to the point at which the gas enters the tube, which is then filled from end to end with brown nitrogen dioxide. When the concentration of nitrogen pentoxide is low, the grey boundary between the colourless incoming gas and its pale brown decomposition products remains stationary and does not strike back.

It is suggested that the formation and disappearance of the blue zone may be due to the production and decomposition of a higher oxide of nitrogen; for example,

$$N_2O_5 + O_3 = 2\,NO_3(\text{blue}) + O_2\,;\quad 2NO_3 = 2NO_2 + O_2$$

The temperature at the boundary is probably below 100°.

T. M. LOWRY.
J. T. LEMON.

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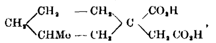
Feb. 15.

Isomeric Forms of Complex Acetic Acid

THE synthesis of 1-carboxy-3-methyl*cyclo*hexane-1-acetic acid by Higson and Thorpe's method[1] gave rise to a small amount of the acid, m p 163°, originally obtained by oxidation of α-keto-3-methyl*cyclo*hexane-1 : 1-diacetic acid[2], accompanied by a low melting point gum which was ultimately resolved into a mixture of two crystalline isomers of this The application of Lapworth and McRea's synthesis[3], on the other hand, gave a more satisfactory yield of the acid melting at 163°, accompanied by only small amounts of the other isomers The isolation of three forms of the acid,



is explicable only on the basis of the assumption of a strainless form of the methyl*cyclo*hexane ring, and the corresponding acids obtainable from 3 3 dimethyl*cyclo*hexanone are therefore being investigated in this laboratory A full report will be published elsewhere in due course

R D. DESAI
R F. HUNTER

Department of Chemistry,
Muslim University,
Aligarh

[1] *J Chem Soc*, **89**, 1455, 1906
[2] Desai, *J Chem Soc*, 1063, 1932
[3] *J Chem Soc*, **121**, 2754, 1922

Effects Produced on Rats by Synthetic Androsteron (Male Sex Hormone)

AT the request of Prof Ruzicka, I undertook the experimental investigation on male and female rats of the biological properties of androsteron and some of his other allied synthetic preparations The following are the first results with androsteron

(1) Androsteron contains both one rat unit of "Comb growth activity" and one rat unit of "whole male sexual activity" (as defined by me[1]) in from 175 to 179 γ, the rat unit approximating to, if not being equal to, the capon unit (Butenandt and Tscherning[2] and Ruzicka and co-workers[3])

(2) The effect of androsteron in increasing the weight of the atrophied prostate of castrated rats is nearly directly proportional to the dose with doses of from 0 2 mgm to 0 9 mgm, after which dose the curve flattens

(3) The daily dose of 1 8 mgm of androsteron injected into castrated rats for 21 days caused an increase in weight of the atrophied prostate by about 800 per cent and of the seminal vesicles by about 500 per cent, of the penis by about 200 per cent and of the preputial glands by about 180 per cent.

(4) In castrated males and in, ovariectomised females androsteron also caused the following changes: a return towards or to normal, a decrease in the weight of the adrenals (hypertrophied after castration), an increase in the weight of the liver, kidney and, in most males, to a slight extent the thyroid (which decreases after castration), the restoration of the normal rate of involution of the thymus, an increase in the appetite and gain in body weight Injections into castrated males also increased the weight of the heart (which is slightly decreased by castration)

In addition to these favourable results on the weight of the organs, histological investigation showed the absence of any toxic effect of androsteron in those organs of castrated rats the structure of which is not considerably changed by castration (liver, kidney and heart) and a return towards or to normal in those organs investigated the microscopical structure of which undergoes severe changes after castration (sexual organs, adrenals).

(5) Androsteron did not cause a return to normal (in weight or histologically) of the hypertrophied hypophysis of castrated males, nor did it produce œstrous in ovariectomised females even when injected in doses of 1·8 mgm for 21 days It also had no 'rejuvenating' effect on old male rats in the doses used (0 1 mgm and 0 9 mgm per day for 21 days)

Repetition of the assay with a second batch of androsteron and of some other experiments are in progress.

V KORENCHEVSKY

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London, S W.1

[1] *Biochem J*, **28**, 1498, 1934
[2] Butenandt, A, and Tscherning, K, *Z physiol Chem*, **229**, 170; 1934
[3] Ruzicka, L, Goldberg, M, Meyer, J, Brüngger, H, and Eichenberger, E, *Helvetica Chim Acta*, **17**, 1395, 1934

A Useful Indicator for the Passage of Food through the Alimentary Tract of Animals

THE following method has been used at this laboratory to indicate the distribution of bacteria in the alimentary tract of the rabbit at various times after they had been given *per os* It was found to work very satisfactorily and appears to have several advantages over the various colouring methods which have been used from time to time in observations on the passage of foods through the intestinal tract of domestic animals and birds.

The indicator is Lycopodium powder (used in pharmacy for covering pills) which is composed entirely of the spores of the staghorn moss, *Lycopodium clavatum* The powder requires to be placed in slightly soapy water before it can be wetted, but this is not necessary if it is to be mixed with food Lycopodium spores are easily recognisable under the microscope, but their chief merit as an indicator for the passage of food through the alimentary tract lies in the ease with which they can be recovered from the ingesta by means of the ordinary sugar floatation technique, as used for the recovery of nematode eggs from the fæces. It also has the advantage that a count of the spores can be made by any of the methods used for counting nematode eggs in fæces, and fairly accurate information so obtained post mortem on the relative amounts of the test dose in various parts of the alimentary tract

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Oxygen Consumption of the Cockroach in Relation to Moulting

DURING experiments on the oxygen consumption of *Blatella germanica*, it was observed that one specimen which was used on the day of its last moult, when it was still pale in colour, had a respiratory rate about 50 per cent higher than the normal. Experiments were accordingly undertaken in which the rate of oxygen consumption of the last stage nymphs of a related species (*Blatta orientalis*) was measured at intervals until after the animals had moulted and become adult. The Barcroft apparatus was used at 25° C.[1]

	Number of observations	Average oxygen consumption in mgm./gm./day, and standard error
11th to 2nd weeks before the moult	29	9.0 ± 0.18
Day of moult and 3 days following	21	14.3 ± 0.37
2nd to 4th weeks after the moult	26	10.4 ± 0.20

Average live weight per animal = 325 mgm.

Ten animals were used, but in only four cases was it possible to carry out an experiment on the actual day of the moult. In these cases the average oxygen consumption was 16.5 mgm. per gram live weight per day, and the rate fell after that day. The accompanying table summarises the results obtained, the figures for the week before and the last four days of the week after the moult being omitted in order that the difference between the periods chosen may be clearly seen. The difference between the rates 'during' (that is, day of moult and three days after) and after the moult is more than nine times the standard error of that difference. The difference between the rates before and after the moult is also quite significant.

Little is known about the internal histological and metabolic changes which take place during the post-embryonic development of exopterygote insects, though they are not nearly so great as the changes accompanying metamorphosis in the Endopterygota[2]. The external skeleton is, however, partly digested and partly shed and a new cuticle is laid down in its place[3]. It is to this process of moulting alone, in the absence of further information, that we may ascribe at present the additional oxygen consumed at this period.

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Feb. 8.

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[2] Needham, D. M., *Biol. Rev.*, **4**, 307; 1929.

[3] Wigglesworth, V. B., *Quart. J. Micr. Sci.*, **76**, 269; 1933.

Collision Frequency and Molecular Density in the F_1 Layer of the Ionosphere

RECENT measurements of the reflection coefficient of the ionosphere, for radio waves between 60 m. and 100 m., have led to a method of determining the collision frequency of electrons and molecules in the region where the ionisation density of the F_1 layer is a maximum. This is, roughly, at a height of some 200 km. above the earth's surface.

The pulse technique of Breit and Tuve was used, and simultaneous records were made of the equivalent height and reflection coefficient of the ionised regions. At certain times the equivalent height rose rapidly to a great value and then decreased again. Simultaneously, the echo intensity decreased to a minimum and then increased again, the minimum intensity corresponding with the maximum equivalent height.

An example is shown in Fig. 1. Such results are interpreted on the supposition that, at the time of maximum equivalent height, the actual frequency ν of the emitted waves is very close to the maximum critical frequency ν_0 of the F_1 region. In such conditions, the extra attenuation shown by the dip in the curve (2) is caused by the collision of electrons with molecules which occur in the neighbourhood of the F_1 ionic density maximum.

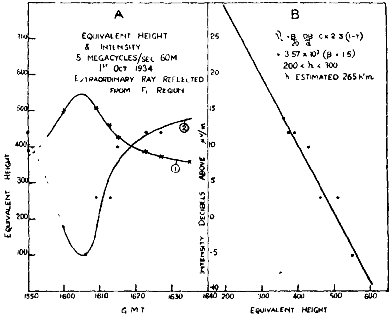

FIG. 1.

The reflection coefficient, in this case, can be shown to be $e^{-t/\beta\tau_c}$ for the ordinary ray, and $e^{-t/\beta\tau_c(1-\tau)}$ for the extraordinary ray, and this is true for vertical incidence whatever the direction of the terrestrial magnetic field. τ_c is the mean time between successive collisions of an electron with the molecules of the atmosphere, $\tau = eH/2\pi m\nu$, and β is a constant[1] equal to $\frac{3}{2}$.

Thus there should be a linear relation between the log intensity and equivalent height (proportional to the delay time *t*). This is illustrated in Fig. 1, *B*. The slope of this line will then give the collision frequency ν_c. In the example illustrated in Fig. 1, $\nu_c = 3.6 \times 10^3$ for an estimated height of 265 km.

The determination of ν_c involves no other quantities than the relative intensities and delay time *t*, which can be measured with a fair degree of accuracy.

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[1] D. Burnett, *Proc. Camb. Phil. Soc.*, **27**, (pt. 4), 578, Oct. 1931.

Electric Impedance of Suspensions of Leucocytes

CONCENTRATED suspensions of rabbit white cells were prepared by the method described by Mudd, Lucké, McCutcheon and Strumia[1] When obtained by this method, about 95 per cent of the cells are polymorphs Microscopic examination and measurement of respiration showed that the cells were in a normal condition The impedance measurements were made at 21·4° C Suspensions having volume concentrations from 10 to 42 per cent, in buffered 0·95 per cent sodium chloride, were used and the resistivity R (ohm – cm.) and parallel capacity C (mμ F/cm) were determined from 0·25 to 16,000 kilocycles per sec [2,3] The values of R and C, as functions of the frequency, are shown for a 42 per cent suspension in Fig 1

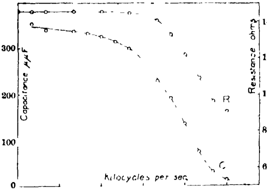

FIG 1 Resistivity (R) and capacity (C) for a 42 per cent suspension of rabbit white cells (average diameter 10·5μ) in 0·95 per cent sodium chloride Resistivity of intercellular fluid 69·0 ohms

The theoretical method of treating these observations has already been described[2,3]. We distinguish between that part of the impedance of the white cell which is attributable to the surface and that part attributable to the interior At low frequencies only the former part is effective and from the (approximate) constancy of C and R, at these frequencies, it is concluded that the impedance at the surface is due to the presence of a poorly conducting membrane which acts as a static condensor By the same criteria, the presence of such a membrane at the surface of the erythrocyte and of the yeast cell has previously been established[2,3,4] The capacity per sq cm of surface of the white cell can be calculated to be 1·0±0·1μF/cm.[3] This value is the same as found for the surface membrane of the erythrocyte[3], within the limits of experimental error With the rather arbitrary value of 3 for the dielectric constant of the membrane, this capacity corresponds to a thickness of 27×10^{-8} cm

From experience with other cells[3,4], it is likely that C and R increase slightly at the lowest frequencies The theoretical significance of this increase as related to the ionic permeability of the membrane has been discussed[3,4]. Unfortunately, due to the rapid settling of the white cells, this increase cannot be accurately measured here, but it cannot be greatly different from that found for the red corpuscle The decrease in C and R at about 128 kilocycles marks the point at which the interior of the cell makes its influence felt The theoretical treatment is not sufficiently developed to allow us to recognise definitely any effects due to a polarisability of the membranes of the internal structures (nucleus, granules, etc.) but, within the present theoretical limitations, the impedance of the interior may be represented as a pure resistance, the specific value of which is calculated[2] to be 140±10 ohm – cm (21·4° C). This value is, within experimental error, the same as found for the mammalian red corpuscle[5]. Since the organic matter content is nearly the same for these two types of cell, this agreement further strengthens the view that the impedance of the membrane of the internal structures in the white cell is negligible at the high frequencies for which the impedance of the internal fluid can accurately be determined

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[1] S Mudd B Lucké, M McCutcheon and M Strumia, *J Exp Med*, **49**, 779, 1929
[2] H Fricke, Cold Spring Harbor Symposia on Quantitative Biology, 1, 117, 1933
[3] H Fricke and H J Curtis, *J Gen Physiol* (in press)
[4] H Fricke and H J Curtis, NATURE, **134**, 102, 1934
[5] H Fricke and H J Curtis, NATURE, **133**, 651, 1934

Moving Striations

WE have recently completed an investigation of the spectra of moving striations in the positive column of some glow discharges Briefly, the method consists in forming an image of the positive column along the slit of a spectrograph, and covering and uncovering the latter by a mechanical shutter made synchronous with the moving striations by a photoelectric device This arrangement gives spectra, the individual lines of which show a longitudinal variation of intensity corresponding to the bright and dark sections of the striations

In the case of a discharge in pure argon, we have examined the dark period carefully for high series lines or series continua, and find them absent. It would therefore appear that recombination of ions and electrons in the gas phase is not important, and since it is known from work by Kenty[1] on argon that such recombination is only appreciable when the average electron energies fall below about 0·5 e v, we conclude that the electron energies in the dark periods exceed this amount This is confirmed by the measurements of Pupp[2] who, in a recent paper, has described the results of probe analysis of somewhat similar discharges and finds in the dark phase electron energies in excess of 1 e v Our optical results are also in accord with his electrical data in that we have found that when a trace of mercury is present, the mercury arc lines 5461 A and 4358 A (excitation potential 7·6 volts) persist strongly through the dark phase although argon lines (excitation potential greater than 12 volts) are, at best, extremely feeble there.

It is satisfactory to find that the optical and electrical studies of these still puzzling phenomena are mutually confirmatory to this extent.

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[1] Kenty, *Phys Rev*, **32**, 624, 1928.
[2] Pupp, *Phys Z*, **36**, 61, 1935

Accuracy of the Curie-Chéneveau Magnetic Balance

I HAVE read with interest, in NATURE of January 26, the letter by Messrs Gray and Cruickshank concerning the Curie-Chéneveau magnetic balance I may mention that I published a small work on this subject so long ago as 1914[1] I found that measurements within one per cent could be made with the greatest ease, and that it was possible to increase the accuracy, with some care, up to a precision of some tenths of one per cent at least The principal cause of errors and fluctuations were due to certain hysteresis effects in the moving parts of the apparatus (though non magnetic) and especially in the damping device My work was done with a somewhat improved type of apparatus due to P Weiss and A Piccard (unpublished, so far as I know)

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[1] F Wolfers, "Mesures Magnétochimiques" Mémoire pour le Diplôme d Etudes supérieures, Faculte des Sciences de Paris, 1914

Points from Foregoing Letters

NEW experiments by Dr C D Ellis and Mr W J Henderson with radionitrogen (the first radioactive element prepared synthetically by M and Mme Joliot by the action of α particles on boron) show that its half-life period is 11 minutes and not 14 minutes, it is thus identical with the half-life period of the radionitrogen obtained from carbon bombarded with protons The difference previously believed to exist between the two types of radionitrogen has been adduced as proof of the existence of negatrons (negatively charged nuclei)

Mr R W Gray's suggestion that whales can descend to 2,500 fathoms or more without suffering from caisson disease is disputed by Dr F D Ommanney He remarks that observations upon the behaviour of whales struck by harpoons offer little indication of their normal habits, and that descent even to two hundred fathoms would involve compression of the lungs to 1/35 of their usual volume

When α-particles hit nuclei of the lighter elements, they do not scatter according to Rutherford's rule (effective for the heavier elements) Prof G Beck and Mr L H Horsley submit a diagram illustrating the electrical barrier surrounding the nucleus, with its various 'energy levels' which are thought to determine the character of the scattering effect, they also indicate the type of scattering that has been observed with various light elements (Be^9, $B^{10,11}$, C^{12}, F^{19}, Al^{27}) They infer that atoms of helium or lithium of mass 5 are unlikely to exist

Dr E Gross and Mr M Vuks submit photographs of spectra of light scattered by crystals of benzene and naphthalene and by liquid benzene, supporting their previous interpretation of the 'wings' observed around the primary line of the spectra, as due in part to slow vibrations of the molecules and not to rotation They point out that the central part of the 'wings', the intensity of which increases on heating, is characteristic of the liquid state

The Wilson cloud chamber, in which condensed water vapour renders visible the tracks of electrified particles, has been one of the most useful instruments in studying subatomic phenomena Mr P Kipfer has constructed a small high-pressure Wilson chamber in which gases compressed up to 100 atmospheres can be used This should increase the probability of atomic collision and reduce the time necessary for observations and the expense of taking a large number of photographs

Mr J W Dunne has put forward the view that time is polydimensional; he considers a succession of 'time within time', and is led by those considerations to assume the existence of freewill and immortality Prof Dingle, while viewing favourably the physical aspects of the hypothesis of 'serial time', considers Mr Dunne's psychological interpretations not justified

Prof T M Lowry and Mr J T Lemon describe an experiment which suggests that a higher oxide of nitrogen (NO_3) is formed transiently when a mixture of nitrogen pentoxide and ozonised oxygen is heated

Synthetic male hormone is found by Dr V Korenchevsky to increase the weight of the atrophied prostate, seminal vesicles, etc, of castrated male rats and to influence the development of female rats from which the ovaries have been removed It does not rejuvenate the male rats or induce œstrus in female rats, as reported for some of the testicular extracts

According to Mr E L Taylor, the spores of the staghorn moss, commonly known as lycopodium powder form a useful indicator for the passage of food through the alimentary tract of animals

Mr D L Gunn has found that there is an increase of about 50 per cent in the rate of oxygen consumption of *Blatta orientalis*, the cockroach, just after its last moult There is a similar rise in respiratory rate at the beginning and the end of the pupal period in insects which develop their wings inside the body until the pupal stage (Endopterygota)

From the relative intensities and delay time of radio pulses reflected from the F_1 electrically conducting layer of the upper atmosphere (about 200 km high), Mr T L Eckersley calculates the collision frequency of electrons and molecules in that layer

The electrical resistance (impedance) to alternate currents, of concentrated suspension of white blood cells (from rabbits) has been determined by Dr Hugo Fricke and Mr Howard J Curtis From experimental results and from special theoretical considerations, they deduce that for low frequencies the resistance measured is that of the cell membrane, while at high frequencies the resistance measured is that of the internal fluid of the cells The thickness of the cell membrane appears to be about 27 A, assuming an arbitrary value of 3 for its dialectic constant

Messrs Sloane and Minnis have obtained instantaneous photographs of the spectra of the moving striations which are a familiar feature of many commercial gas-discharge illuminating tubes They find that the variations of the spectra through the bright and dark parts of the striations are in accord with what is known of the electrical properties of this form of discharge.

Research Items

Ethnology of Mysore. The Baron von Eichstedt, who himself has recently visited Mysore, contributes an introductory chapter on the racial history of Mysore in relation to that of India to "The Mysore Tribes and Castes", vol. 1 (Bangalore: Government Press). Mysore, like India as a whole, presents a fundamental contrast of open landscape and preponderantly mountainous jungle districts. Here also there is the same racial parallel: in the open country, settlements of a people of a progressive type, who are fair in the north of India and dark in the south and in certain refuge areas; and in the jungle districts primitive peoples who are fair in the western areas and dark in the eastern. Thus in India as a whole there are three main groups, each subdivided into two:—(1) The racially primitive peoples of the jungle region, the Ancient-Indians or Weddid racial group, divided into the Gondid race, a dark-brown curly (wide) haired people with totemistic mattock-using culture; and the Malid type, a black brown curly (narrow) haired people with originally ancient culture. (2) The racially mixed group Black-Indians, or Melanids, divided into the black-brown progressive people in the most southern plains with strong foreign matriarchy, the southern Melanids; and a black-brown primitive people of the northern Deccan with strong foreign (totemistic and matriarchal) influence, the Kolid type. (3) The racial progressive people of the open regions, New Indians or Indid group, divided into a gracile brown people with enforced patriarchy—Gracile-Indid race; and a coarser light brown people with possible original patriarchal herdmanship: the North Indid type. So in Mysore is found the best preserved and most primitive of the primitive inhabitants of India, the Malids, with the later Gondids intruding, pre-Aryan North Indid herdsmen in the remnant of the Todas and traces of North-Indids all over the State, mixing with the older and partly younger intruders foreign to India, Palæo-mongolids, 'West-Brachids' and orientaloid Mohammedans.

Yao Education. In a study of the Yao tribe of Nyasaland, by Father Benno Heckel (University of London Institute of Education: Studies and Reports, No. 4. Oxford University Press. Pp. 53. 2*s.* net) an account is given of the initiation of boys and girls. These ceremonies represent a real fountain of life and are the basis of continued tribal existence. Information is difficult to obtain, as the greatest secrecy about them is maintained, and any violation would entail death. Initiation of boys takes place at 14–17 years of age. Each candidate is assisted by a patron, an elder man, who acts as tutor or instructor, and there is a leader, the 'Tail-bearer', who carries a zebra tail as a mark of distinction. The period of the initiation course is prolonged to three or four months, during the whole of which the novices must live in the place of initiation and submit to a severe discipline. They bathe before sunrise and are thereafter kept hard at work for the whole day. Ineradicable habits and perfect knowledge are inculcated by songs, hymns, dances and games. The course does not consist of abstract instruction, but of a pleasing and concrete form of education up to the standard of knowledge and practice of adult life. Sanctions corresponding to duties are taught by practical demonstration; for example, if punishment is death by a lion, on a very dark night the roaring of a lion nearby will be heard and continue until the novices promise fidelity. They are taught standards of politeness, hospitality and friendship, the history of the tribe and its phratries, tribal laws, rules of marriage, the names of the plants and animals they are not allowed to eat, the duties of marriage and conjugal intercourse and the like. After a ceremonial return to the village, the novices are considered to be adult, and undertake men's duties.

Geographical Variation in Number of Teeth. The Cyprinid family of fishes includes some two hundred genera distributed in all parts of the world except South America, Australia and Madagascar. The rows of pharyngeal teeth are distributed among these genera in numbers which have a clear geographical significance (V. D. Vladykov, *Copeia*, 1934, p. 134). Thus genera with three rows of pharyngeal teeth do not occur in America and one row genera somewhat exceed in number two row genera. In Europe about 9 per cent of the genera have three rows, and two rows are dominant. At the other extreme, Africa has only two one-row species and 90 per cent have three rows, species been taken here for comparison since the genera are few (8). The accompanying table shows more clearly than description could show the relationships of the numbers.

Regions	Percentage Nos. of rows of pharyngeal teeth			Total No. of genera
	1	2	3	
North America	46·0	40·5	– –	37
Europe	41·0	50·0	9·0	22
East Asia	23·0	23·0	49·0	57
India	8·0	12·0	68·0	25
Africa (species)	0·6	3·0	90·0	262 species

Systematics of the Penæids. Mr. Martin David Burkenroad discusses the littoral and sub-littoral penæids of the world, the present studies being mainly centred about American Penæinæ and Eusicyoninæ ("Littoral Penaeidae chiefly from the Bingham Oceanographic Collection, with a Revision of *Penaeopsis* and Description of two New Genera and Eleven new American Species" (*Bull. Bingham Oceanographic Coll.*, 4, Sept. 1934). In further work he proposes to continue this revision to complete a monographic account of the group. The tropical west coast of America is found to be extraordinarily rich in penæids, ten of the eleven new species described in the present paper coming from the Pacific, one belonging to a new genus; and much that is new and interesting is shown in the distribution of the various species. A systematic revision was evidently much needed and the present account is full of careful comparative work based on the examination of material from different sources, necessitating certain alterations in the existing classification. Special attention is given to the petasma, for which a generally applicable terminology is prepared, and the internal morphology, homologies and probable mode of operation of the thelycum in a number of the Penæinæ are described, including a discussion of certain methods of separation of the entrance and exit to the sperm receptacles; a series of excellent text figures of those structures is given.

Amœboid Cells in Invertebrates. A useful summary of the different kinds of amœbocytes and allied cells in invertebrates has been prepared by Isabel Haughton (*J. Roy. Micro. Soc.*, 54, Pt. 4, Dec. 1934). The blood cells of invertebrates show types of stages corresponding with those found in vertebrates, but in addition are others, such as the adipo-spherical cells (spherical cells filled with fat globules and protein spheres) found free in the cœlomic fluid of Annelida or aggregated into a tissue in insects, which do not correspond with any cells found in vertebrates. Amœboid movement is common in the leucocytes of invertebrates, but the property of thigmotaxis—the spreading of the corpuscles when they come into contact with a foreign body—which is irreversible, has often been mistaken for amœboid movement which is reversible, for the pseudopodia can be withdrawn. The leucocytes often exhibit phagocytosis, and they play a large part in digestion and excretion, especially in the bivalve molluscs, in which they ingest food material, as they lie between the epithelial cells in the wall of the stomach, and transport it thence to the connective tissue where they digest the food. Coagulation of blood is found among invertebrates only in some Crustacea; the formation of clots in other invertebrates is due to agglutination or clumping of the blood cells. In the examples studied, phagocytes are widely distributed throughout the body, especially in connexion with the digestive organs and in the connective tissue. Lymph glands have been demonstrated only in very few invertebrates and therefore the origin of the amœbocytes and blood cells is obscure. Mitosis has been observed in the small hyaline cells, and the general impression is that from this the other types are developed by acquisition of granules.

Development of a Braconid Parasite. Mr. P. M. Glover, of the Indian Lac Research Institute, Ranchi, India, has recently published a paper on the development of *Bracon tachardiæ*, Cam. (*Bull. Entomol. Res.*, December 1934). The species in question is an ectoparasite of the larva of the moth *Eublemma amabilis*, which is an important predator on the lac insect. The first five larval instars of *Bracon* are described and certain structures are figured in some detail, while an analysis of their growth phases is given. It is found that head-width is a safe indication of a given instar since extremes rarely occur; the widths calculated on Dyar's principle also approximate sufficiently closely to the observed widths to preclude the overlooking of an ecdysis. The length of the mandible is identical in a given instar and its exuviæ, and allows of their grouping, particularly if averages be taken: the range for a given instar is wide, but the extremes do not overlap. The factors for increase of head-width and mandible-length are fairly similar, falling near to 1·26. The growth of the body of the larva from instar to instar is independent of head growth, larvæ increasing in weight and volume by a figure lying between 3 and 4 times, from instar to instar, and closely approaches the theoretical figure for volume (3·6). It is suggested that similar observations may be true for other ectoparasitic Braconidæ.

Bihar Earthquake of 1934. At the meeting of the Geological Society of London on February 6, a lecture on the Bihar-Nepal earthquake of January 15, 1934, was given by Dr. J. A. Dunn, who directed the study of the earthquake on behalf of the Geological Survey of India. The fracturing that caused the earthquake lay beneath the deep alluvium of the Gangetic plains. The direction of oscillation was usually parallel to the trend of the epicentral region, not radial to it, suggesting that the initial movement was principally along the strike of the fault. The total duration of the earthquake was about five minutes, most of the damage being done during the latter half of the disturbance. Surface undulations, 6–12 ft. long and perhaps 6 in. high, were seen even at a distance of 200 miles from the epicentral area. An interesting feature of the map of isoseismal lines is the occurrence of alternating zones of less and greater intensity outwards from the central tract, due probably to displacements along secondary lines of weakness. Within the central isoseismals lay a belt, 190 miles long, in which tilting of buildings and collapse with subsidence of the ground was more marked than actual destruction by vibration. The belt probably lay over that part of the fracture along which differential movement was greatest.

Soil Survey in Berkshire. The University of Reading has already published a soil survey of the county of Berkshire, but it was clear that an intensive study of certain areas with the use of more modern methods was desirable if an explanation was to be obtained as to why fruit growing had been able to establish itself as an important industry in a certain part of the Vale of the White Horse. A detailed survey of this area has, therefore, been recently carried out by Dr. F. F. Kay and the results published by the University of Reading as Bulletin 48, "A Soil Survey of the Eastern Portion of the Vale of the White Horse". The district was found to fall into four natural areas, which are described in detail, and the soils, classified on the basis of their soil profile characteristics, grouped into twenty soil series, the appropriate weed flora being described for each. The calcareous nature of the majority of the soils necessitated the use of certain modifications of the usual methods of analysis, especially in connexion with mechanical analyses and the determination of exchangeable potassium. High figures for potassium saturation were correlated with a siliceous type of clay and free drainage conditions, and a classification of base saturated calcareous soils is suggested on the basis of the nature of the clay fraction. The most useful fruit soils were characterised by free drainage conditions, a high degree of potassium saturation and a siliceous type of clay. Excellent cherries could be produced on the Blewbury and Harwell series and very good quality apples grown on the Hendred and Harwell series. Potash manuring was shown to be essential on the light loams of the Corallian.

Dust in the Air. The January issue of the *Review of Scientific Instruments* contains a description of an instrument for taking direct photographs of dust in the air, devised by Messrs. L. H. Ott and J. B. Ficklen, of the Sloan Physics Laboratory of Yale. The usual methods of collecting the dust in water or allowing it to settle on a plate of glass, or making the air containing it impinge on a glass surface to which the dust adheres, they consider unsatisfactory, and have found that by using strong illumination they can photograph the dust particles. The air to be tested is drawn into the lower portion of a vertical tube which is then closed. The upper part contains a camera directed downwards and focused on a thin horizontal band of the air, which can be strongly illuminated for an instant through a window in the side of the tube by a photographic flash lamp outside the tube. A supersensitive panchromatic film is used and the whole apparatus weighs only 5 lb. A photograph of chalk dust particles which vary in size from 1×10^{-3} to 5×10^{-3} cm is reproduced.

Theory of the Auger Effect. E. H. S. Burhop (*Proc. Roy. Soc.*, A, Feb. 1) has investigated theoretically the radiationless transformation by which an atom ionised in, say, the *K* shell, may re-arrange itself by an electron falling in from another shell and giving up its excess energy to another electron, which is expelled from the atom. The quantum mechanical approach is similar to that used by Hulme to consider the internal conversion of γ-rays. Hydrogen-like wave functions were used to represent the two electrons, the nucleus being supposed to be screened according to Slater's rules. The probability of transition between the initial state and the final state (one electron in the *K* shell and one electron unquantised) is calculated by means of a formula of Dirac, an allowance being made for the fact that either of two electrons may fall into the *K* shell, the other being ejected. There is no means of distinguishing these processes experimentally. The intensity of the *K* radiation is also calculated so that the probability of radiative and radiationless transformation may be compared. Numerical calculations are carried out and compared with experimental results. The variation of the internal conversion with atomic number is satisfactorily given, and the variation of intensity among different transitions in the atom is also obtained in agreement with experiment.

Transmutation of Sodium by Deutons. E. O. Lawrence (*Phys. Rev.*, Jan. 1) has made an extensive study of the nuclear reactions produced in sodium by H^2+ ions having energies of 1.7 million volts. The following transmutations take place.

The production of radio-sodium

$$ {}_{11}\mathrm{Na}^{23} + {}_{1}\mathrm{D}^{2} \rightarrow {}_{11}\mathrm{Na}^{24} + {}_{1}\mathrm{H}^{1}, $$

followed by

$$ {}_{11}\mathrm{Na}^{24} \rightarrow {}_{12}\mathrm{Mg}^{24} + e\,, $$

alternatively

$$ {}_{11}\mathrm{Na}^{23} + {}_{1}\mathrm{D}^{2} \rightarrow {}_{12}\mathrm{Mg}^{24} + {}_{0}n^{1}, $$

and possibly

$$ {}_{11}\mathrm{Na}^{23} + {}_{1}\mathrm{D}^{2} \rightarrow {}_{10}\mathrm{Ne}^{21} + {}_{2}\mathrm{He}^{4} $$

The radio-sodium was produced in considerable quantity (equivalent to about $\frac{1}{2}$ mgm. radium) and it is suggested that it may be produced in this way for biological work. Its decay period was measured with an electroscope, and gave a value of 15.5 hours, similar to that of the radio-sodium obtained by Fermi by a different process. Absorption measurements were made on the β rays, giving a probable maximum energy of about 1.2 mv. About one γ-ray was found to accompany each β-transformation, the γ-rays being probably monochromatic and of energy of the order of $5\frac{1}{2}$ mv. These γ-rays should be valuable, for example, in the study of electron-positron pair production. The protons accompanying the activation of sodium were identified and their energy distribution studied. The Gamow theory was found to account for the variation of radio-sodium yield with bombarding potential. Neutrons and α-particles corresponding to the alternative reactions above were also found.

NO_2F. By the action of fluorine on moderately concentrated nitric acid, an explosive colourless gas of the formula NO_2F is produced (G. H. Cady, *J. Amer. Chem. Soc.*, **56**, 2635; 1934). The vapour density is about 82, the boiling point about − 42°. The gas is fairly stable at room temperature, but explodes on heating. It has an irritating odour. NO_2F is moderately soluble in water, with which it reacts slowly, liberating oxygen. It liberates iodine from potassium iodide, forming a nitrate and fluoride, and reacts with potassium hydroxide according to the equation $NO_2F + 2OH' = \frac{1}{2}O_2 + F' + NO_3' + H_2O$.

Mechanism of the Biological Oxidation of Ammonia. Messrs. Gopala Rao and K. M. Pandalai, writing from the chemical laboratories of the Andhra University, Waltair, India, state that they have investigated the possibility of the formation of hydroxylamine as an intermediate product in the oxidation of ammonia by nitrifying bacteria. Various tests for hydroxylamine were employed, but always with negative results. There was no difficulty in detecting its presence after addition of small quantities to the cultures. The positive results recorded by Mumford (1914) are attributed to the use of impure cultures, and the confirmation given by Mazé (1921), Kluyver and Donker (1926) and Fowler (1934) is not based on experimental evidence.

A New Cold-Cathode Amplifying Valve. A paper entitled "An Electron Multiplier" describing a new type of cold-cathode amplifying valve developed by P. T. Farnsworth of the Television Laboratories, Ltd., U.S.A., has recently been received (*Electronics*, August 1934). This new valve is a high vacuum amplifier, which promises to find considerable application in television and other aspects of radio communication. The valve is cylindrical in shape and contains two cold cathodes, one at each end, with a metal ring anode mounted centrally between them. An electron produced photo-electrically is accelerated towards the anode, which is maintained at a high positive potential relative to the cathodes. A longitudinal magnetic field, produced by an external circuit, deflects the electrons, so that they miss the anode and strike the second cathode, where they produce secondary emission. The additional electrons so produced then travel in the reverse direction and the whole process is repeated. In order to ensure that the electrons arrive at the cathodes with sufficient velocity to dislodge further electrons, a potential difference of the order 25–90 volts at a frequency of 50 megacycles per second is applied between the two cathodes from a circuit tuned to this frequency. As the secondary emission process builds up, the current in this tuned circuit increases; and this current can be controlled by the external magnetic field and by the steady voltage applied to the anode. A maximum effect is obtained when this steady voltage is such that the transit time of the electrons between the cathodes is an odd multiple of half the period of the oscillations. It is stated that the actual current magnification obtained is enormous, since the electrons may make as many as a hundred complete transits of the tube, each time producing as many as six secondary electrons per original carrier. Different types of valves have been produced for amplification and oscillation, but much further research appears to be needed on the problem of making the valves uniform and efficient.

Foundation of the National Institute of Sciences of India

AT the twenty-first session of the Indian Science Congress, held at Bombay in the first week of January 1934, the General Committee considered the various suggestions regarding the foundation of an Indian Academy of Sciences that had been made during the previous year, and appointed a representative committee with the object of drafting a constitution to be laid before the next meeting of the Indian Science Congress, and to take necessary steps to bring the Academy into existence

The General Committee was of opinion (Resolution II) that the principal purposes for which an Indian Academy of Sciences was desirable were

(i) To act as a co-ordinating body between scientific societies in India, institutions, and Government scientific departments and services

(ii) To act as a body of scientific workers of eminence to promote and safeguard the interests of men of science in India and also to act as a National Research Council

(iii) To publish a *comptes rendus* of papers read before the Academy and also Memoirs and Transactions

(iv) To promote and maintain a liaison between men of science and men of letters

(v) To secure and manage funds and endowments for scientific research

(vi) To do such other things as may be necessary for the promotion of science in India

This Committee had an original membership of 24, which was increased during the year to 39 by co-opting members representing various interests, as was found desirable The Committee held seven meetings and an emergency meeting At those meetings the various points of view were considered very carefully and a scheme for the foundation of a National Institute of Sciences of India was evolved

In accordance with the direction to take necessary steps to bring the Academy into existence, the Academy Committee had submitted its proposals to a hundred of the leading men of science of India representing all branches of science, and invited them to become its foundation fellows. An additional 25 scientific workers were invited to become foundation fellows on the vote of the first 100 foundation fellows, making a total of 125 foundation fellows The scheme makes provision for the election of not more than ten ordinary fellows annually, in addition to a certain number of honorary fellows

This scheme was placed before the General Committee of the Indian Science Congress held on January 3, 1935, and adopted unanimously, together with a recommendation that twenty-five ordinary fellows be elected in the first year instead of ten The proposal for adoption was moved by Dr L L Fermor on behalf of the Academy Committee and was supported by representatives of the General Committee (Prof P N Ghosh), Asiatic Society of Bengal (Sir U N Brahmachari), U P. Academy of Sciences (Prof K N Bahl) and Indian Academy of Sciences (Prof B. Venkatesachar).

At the inaugural meeting, which was held on January 7, 1935, Dr. J. H. Hutton, as president of the Indian Science Congress, requested His Excellency Sir John Anderson, Governor of Bengal, to inaugurate the National Institute of Sciences of India

In inaugurating the first session of the National Institute of Sciences of India, His Excellency Sir John Anderson referred to the various stages in the progressive organisation of modern science in India He said that the foundation of a society of varied and comprehensive character, such as the Asiatic Society of Bengal, was the first stage, followed three quarters of a century later by the foundation of universities and specialist scientific services The third stage was reached half a century later with the foundation of the Indian Science Congress holding annual meetings of individual scientific workers, leading, after the lapse of a quarter of a century, to the foundation of a central and all-India co ordinating body, the National Institute of Sciences of India, embracing all modern scientific research in India

His Excellency's speech was followed by the presidential address of Dr L L Fermor, F R S, who has been elected its first president Dr Fermor traced the history of the development of scientific research in India in the twentieth century, leading up to the formation of the National Institute He further explained the co ordinating functions of the National Institute *vis-à-vis* the Academies of Sciences in India, and the method by which it is proposed to ensure their co operation The objects of the National Institute are stated to be "the promotion of natural knowledge in India including its practical application to problems of national welfare", which is indeed a very comprehensive programme

The Institute will act as a body of men of science of eminence to promote and safeguard the interests of scientific workers of India By the publication of a *comptes rendus* containing summaries of the papers read before all Academies of Science in India and by the preparation of an annual report on the progress of science in India in all its branches, it will focus attention on the research work being done in the country and indicate the lines in which progress is desired

The National Institute will also be prepared to act through properly constituted National Committees in which other learned academies and societies will be associated, and as the National Research Council of India, for undertaking such scientific work of national and international importance as required by the public and by Government. The National Institute and the Academies of Science in India will have mutually complementary functions and will co-operate with each other as independent organisations The National Institute will thus occupy a very important place in the scientific life of India, and its activities will be a potent factor in India's national progress

The inaugural meeting was followed by the first ordinary general meeting of the National Institute, which was held on January 8, 1935, in the rooms of the Asiatic Society of Bengal This meeting was attended by thirty-seven foundation fellows and a large number of visitors from among the members of the Indian Science Congress The result of the ballot for the election of the first council of the National Institute was announced at this meeting The Council for 1935 is constituted as follows .

President : Dr L L Fermor, director of the Geological Survey of India, Indian Museum, Calcutta

Vice-Presidents · Brigadier H J Couchman, Surveyor-General of India, Calcutta ; Prof. B Sahni, professor of botany, University of Lucknow.

Treasurer: Dr S L Hora, assistant superintendent, Zoological Survey of India, Indian Museum, Calcutta

Foreign Secretary: Prof M N Saha, professor of physics, University of Allahabad

Secretaries Prof S P Agharkar, Ghose professor of botany, University of Calcutta Dr A M Heron, superintendent of the Geological Survey of India, Indian Museum, Calcutta

Members of Council Mr M Afzal Hussain, principal of the Punjab Agricultural College, Lyallpur, Punjab, Mr T P. Bhaskara Shastri, director of the Nizamiah Observatory, Begumpet, Hyderabad, Deccan, Dr S S Bhatnagar, university professor of chemistry and director of the University Chemical Laboratories, Lahore, Mr B C Burt, agricultural expert, Imperial Council of Agricultural Research, New Delhi (and Simla), Prof J C Ghosh, head of the Department of Chemistry, University of Dacca, Ramna, Dacca, Dr F H Gravely, superintendent of the Government Museum, Museum House, Egmore, Madras, Lieut Col R Knowles, professor of protozoology, School of Tropical Medicine, Calcutta; Dr K S Krishnan, Mahendralal Sircar professor of physics, Indian Association for the Cultivation of Science, 210 Bow Bazar Street, Calcutta, Prof S K Mitra, Khaira professor of physics, University of Calcutta, University College of Science, Calcutta, Prof J N Mukherjee, Khaira professor of chemistry, University of Calcutta, University College of Science, Calcutta, Dr C W B Normand, director-general of observatories, Meteorological Office, Poona 5, Prof Ganesh Prasad, Hardinge professor of higher mathematics, University of Calcutta, Dr Baini Prasad, director of the Zoological Survey of India, Indian Museum, Calcutta, Sir C V Raman, director of the Indian Institute of Science, Bangalore, Lieut-Col S S Sokhey, director of the Haffkine Institute, Parel, Bombay, Lieut-Col J Taylor, director of the Central Research Institute, Kasauli (Simla Hills), Mr S C Trevor, president of the Imperial Forest Research Institute, Dehra Dun, Mr F Ware, director of the Imperial Institute of Veterinary Research, Muktesar

The following representatives, in each case a vice-president and a member of council, of scientific bodies in India were also appointed

Asiatic Society of Bengal Sir U N Brahmachari, Medical College Hospital (Retired); Mr C C Calder, director of the Botanical Survey of India and superintendent of the Royal Botanic Gardens, Sibpur, Howrah

U P Academy of Sciences: Prof K N Bahl, professor of zoology, University of Lucknow; Prof. A C Banerji, professor of mathematics, University of Allahabad

Indian Academy of Sciences: Prof B K Singh, professor of chemistry, Ravenshaw College, Cuttack; Dr K V. A Krishnan, bacteriological research officer, School of Tropical Medicine, Calcutta.

Indian Science Congress Association: Dr J H Hutton, deputy commissioner, Naga Hills, Kohima, Assam, Mr W D West, assistant superintendent of the Geological Survey of India, Indian Museum, Calcutta

At this first ordinary meeting, eleven papers were read, the titles of which are given below

(i) "Synopsis of the Pre-Vindhyan Geology of Rajputana" by Dr A M Heron

(ii) "Physiology, Bionomics and Evolution of the Air-Breathing Fishes of India" by Dr S L Hora

(iii) "Problems of the Solar Corona" by Prof. M N Saha

(iv) "Ionospheric Height Measurements at Allahabad" by Mr. G R Toshniwal (communicated by Prof M N Saha)

(v) "On the Electron Theory of Metals" by Dr R C Majumdar, University of Lahore (communicated by Prof M N Saha)

(vi) "On Symmetrical Space with Minimum Rate of Expansion" by Prof N R Sen

(vii) "New Facts regarding Infection of *Citrus colletotrichum gleosporoides*" by Dr H Chaudhuri, Lahore

(viii) "Synthetic Enzyme" by Prof H K Sen and Mr Sobhanlal Banerji

(ix) "On the Question of the Expansibility of Zero in the Series of Legendre Functions having Non-integral Parameters" by Prof Ganesh Prasad

(x) "On the Cataphoretic Speed and Inorganic Colloids" by Prof J N Mukherjee, Mr S G Chaudhuri and Mr B N Ghosh

(xi) "Mon and Munda in India and Beyond" by Dr. J H Hutton

It may be confidently expected that the National Institute of Sciences of India will play an increasingly important part in the development of scientific research in India

Mechanical Testing of Timber

IN September 1928 a committee was appointed by the Committee of the Privy Council for Scientific and Industrial Research to report "On the Mechanical Testing of Timber" This report[*] has now been issued (London H M. Stationery Office, 1934) The Committee had its origin as a consequence of work done during the War, in connexion mainly with the design of aircraft, when the testing of timber became a matter of particular importance; as was shown by the amazing development in aircraft construction and reliability In 1920, a report was published under the auspices of the Aeronautical Research Committee "On the Materials of Construction used in Aircraft and Aircraft Engines", by Lieut-Col. C. F Jenkin, professor of engineering science in the University of Oxford. Prof. Jenkin had served as director of the Materials Section of the Technical Department, dealing with the production of aircraft under the Ministry of Munitions Chap x of the report dealt with the mechanical properties of timber in a comprehensive manner

The Committee appointed in 1928 consisted of the late Sir Alfred Ewing (chairman), Prof. C F Jenkin, Prof. A Robertson and Messrs. W. D Douglas and C. J Chaplin The terms of reference were taken as implying "an unrestricted review of the testing of timber for strength and elasticity" This necessarily included consideration in detail of the methods of testing in use at the Forest Products Research Laboratory, Princes Risborough. Various investigations were carried out at this Laboratory during the course of the investigation. Other important experiments were carried out for the Committee by Prof E G Coker in his laboratory at University

College, London, and by Mr. Douglas at the Royal Aircraft Establishment.

The history of the development of the mechanical testing of timbers is not without interest. The system followed in most laboratories is practically that devised by the United States Forestry Service, and is the outcome of a scheme proposed in 1891 by Mr. B. S. Fernow, then chief of the U.S. Forest Service. At a somewhat earlier date, the Prussian Government had laid down a basis for timber testing, and Fernow stated that the two methods were practically the same, except that in the United States "the need of practically applicable results has been kept in the foreground". The American system received a further development about 1902 when it was adopted in the newly established Forest Products Laboratory at Madison, Wisconsin. In 1920, the U.S. Forest Service requested the American Society for Testing Materials to consider the standardising of timber tests, and the methods then formulated were adopted in 1925 by the newly instituted British Forest Products Research Laboratory. Before this, they had been substantially accepted in the procedure of the Forest Products Laboratories in Canada, India and New Zealand. They have also been adopted by Australia, the Federated Malay States and to some extent by Sweden, Poland and Japan.

The Committee points out that its investigations are only concerned with mechanical tests on small 'clear' specimens of timber—that is to say, specimens which are free from knots, shakes or other defects. The work of forest products laboratories, it realises, is concerned with both large and small specimens.

It is impossible here to follow the Committee through the investigation work carried out which enables it to form its conclusions. It should be mentioned that the testing methods in use at the time had been adopted as standard ones and included the British standard specification for methods of testing small clear specimens of timber (No. 373–1929) issued by the British Standards Institution. Although from a practical point of view the tests were the best that could have been devised with the knowledge then available, it was generally felt that several of the methods commonly employed were open to criticism from a scientific point of view. An opinion in this sense expressed to the Department in 1928 by Prof. C. F. Jenkin led to the appointment of the Committee which has presented the report now before us.

The Committee's Report concludes with the following: "Broadly speaking the several purposes for which mechanical tests for timber are, or may be, undertaken may be classified as follows:—

I. Tests which regard timber from the point of view of the physicist as a material for scientific examination, apart from any intended practical application.

II. Tests which regard timber from the point of view of the engineer as part of a structure that is to be designed to carry certain loads or perform other specified duties.

III. Tests appropriate for the grading of a number of timbers or for judging of their conformity to a given specification."

"Much, but by no means all, of the work of a Forest Products Laboratory falls within the third category and may properly involve methods of testing which would not be appropriate for the first purpose or even the second. On the other hand, tests suitable for the first purpose, or the second, are often attended by difficulties and restrictions which would put them out of court as matters of routine. It is clearly desirable that, subject to these considerations, the interpretation of all tests should be intelligible and their results definite; but it should be recognised that in providing for the various purposes here roughly indicated, tests of widely different character must be contemplated and they will be subject to different canons of criticism."

Timber testing has a growing value in the world of to-day, and the work of this Committee will be received with high approval and gratitude by research centres throughout the world.

National Inland Water Survey

THE paper on "National Inland Water Survey" by Dr. Brysson Cunningham, read at the meeting of the Royal Geographical Society on March 11, set out the scope of a survey required, not merely to serve the responsibilities of the Ministry of Health in regard to water supply for domestic purposes, but also to meet the needs of industry and commerce, the possible development of hydro-electric motive power, the requirements of irrigation, fisheries and navigation, the drainage of low-lying lands, the prevention of floods and other equally important matters. It defined a national survey, in the technical and only satisfactory sense of the word, as a comprehensive and accurate measurement and complete registration, so far as may be practicable, of all the water to be found in a country, whether contained in lakes, rivers, streams, wells, artificial reservoirs, or subterranean strata and cavities. A survey, it stated, should be regarded as a purely scientific undertaking, necessitating special technical knowledge and supervision, and in order to ensure its absolute impartiality, where so many different and possibly conflicting purposes are to be served, it should, as recommended by the Committee of the British Association, be conducted by an organisation "independent of any interest in the administration, control or use of water", such an organisation being available in the Department of Scientific and Industrial Research, which is equipped for work of this kind and possesses the essential scientific authority.

Proceeding to outline the programme of a survey, attention was directed, in connexion with rainfall, to the work of the British Rainfall Organization, which for a number of years past has carried out in an admirable manner the superintendence, collection and publication of data. Evaporation and soil absorption have not yet received the degree of attention needed for the purposes of a survey. It is also a regrettable fact that, up to the present time, there has been no department, or central organisation, constituted to deal with direct hydrological measurements of the amount of water actually derived from rainfall. While certain undertakings take gaugings for their own purposes, these are relatively few and the observations are not accessible by the public. The determination of run-off, that is, the bulk of the water which, following rainfall, escapes to the sea, constitutes therefore the greatest field of activity for the survey. The records of the Thames Conservancy at Teddington Weir were instanced as one of the few cases of really effective river measurement. In England and Wales, much assistance in regard to stream gauging can be rendered by the Catchment Boards instituted under the Land Drainage Act, 1930.

The investigations of the British Association Committee were briefly described, and Dr. Cunningham then proceeded to review the methods and organisations adopted in certain other countries, namely, Canada, the United States, France, Germany, Switzerland and Italy. A number of lantern slides were exhibited illustrative of typical apparatus and installations in operation in the respective services. It was shown that in all these countries, in addition to rainfall measurement, great importance is attached to the consistent gauging and measurement of river- and stream-flow and to the publication of the results obtained, so as to be accessible by all who are interested.

Dr. Cunningham urged that it should be considered an essential part of the duty of those in charge of a survey to disseminate information and advice to local authorities and others engaged in the exploitation of water supplies and the control of floods. Finally, he said it would largely nullify the value of a survey if it were limited to the mere collection and filing of records and statistics. The keynote of the organisation should be active research.

Fungi of South Australia

A VERY useful series of handbooks on the flora and fauna of South Australia is prepared by the British Science Guild (South Australia Branch) and published by the Government of South Australia. The editorial committee shows that "there is an admitted lack of inexpensive but accurate books dealing with the plants and animals of South Australia, and it is felt that the absence of such has been a real handicap to young Australia, and so to the progress of Australian Science".

Handbooks on the general flora, mammals, fishes, the building of Australia and the succession of life, crustaceans, and reptiles and amphibians have already been published, while seaweeds, spiders, moths and butterflies, ants and birds are to be described in future volumes. The gratuitous services of recognised authorities on particular subjects have been obtained, whilst the Government of South Australia publishes the volumes at low prices. In spite of the serious depression through which South Australia has been passing, the Government has shown a commendable breadth of vision, and earned the gratitude of all scientific workers by continuing to publish this series.

Part 1 of the handbook on "Toadstools and Mushrooms" before us is by Prof. J. B. Cleland, chairman of the Handbooks Committee, and combines scientific exactitude with a simplicity of statement which should bring the knowledge within reach of any intelligent person. The introductory sections are particularly well written. They deal first with general questions of distribution and activity, and then with uses of fungi, poisoning, fungi and art, localities affected by different species, fungi and bush fires, larger fungi eaten by mammals, insects and other animals, luminescence of fungi, fairy rings, mechanical force exerted by fruiting bodies, methods of collection and preservation, and descriptions of special terms used in classification.

This takes up forty pages of closely-printed text, and the remaining 138 pages are devoted to a general classification of the higher fungi, and to a detailed classification of the Agaricaceæ. The system adopted for the latter combines the orderly, reasoned groupings set forth by Carleton Rea (in "British Basidiomycetæ") with the convenient detail of Claussen's subdivision by spore colour. This combination is used by the foremost students and teachers of mycology in Great Britain. Convenient keys to the species, as well as to the genera, are given.

Thirty-five photographs and drawings and six coloured plates enrich the text, and the price of five shillings is certainly extremely low for such a volume. Copies may be obtained from the Government Printer, North Terrace, Adelaide. British students of mycology can find a wealth of helpful description for many of our native species.

University and Educational Intelligence

CAMBRIDGE.—The Department of Scientific and Industrial Research has offered £2,300 for building and equipping an extension to the Low Temperature Research Station on its southern side. It is to be used in perpetuity for scientific research and in the first instance for research on problems arising out of the preservation and handling of foodstuffs. In the letter making this offer, it is stated that the Committee of Council has had under consideration the possibility of further extensions of the Station in the future, and that the only areas where such extensions appear to be practicable are at the southern end of the eastern side of the Station and at its north-eastern corner. Having regard to the developments which have taken place since the Station was first erected, the Committee considers it desirable that these two areas should be reserved against future needs.

The Smith's Prizes are awarded to H. G. Booker, of Christ's College, and L. Howarth, of Gonville and Caius College. Rayleigh Prizes are awarded to A. F. Devonshire, of Trinity Hall, T. E. Faulkner, of Gonville and Caius College, and F. Smithies, of St. John's College.

EDINBURGH.—The Senatus Academicus has resolved that the honorary degree of LL.D. be offered to the following, for conferment at the Graduation Ceremonial to be held on June 28:—The Right Hon. Lord Bledisloe of Lydney, Governor-General and Commander-in-Chief of New Zealand; Dr. Nicholas Murray Butler, president of Columbia University, New York; Dr. James L. Garvin, editor of the *Observer*; Mrs. M. M. Ogilvie Gordon, geologist, and vice-president of the International Council of Women; Prof. J. Graham Kerr, regius professor of zoology in the University of Glasgow; Prof. John Laird, regius professor of moral philosophy in the University of Aberdeen; Sir George Macdonald, formerly secretary of the Scottish Education Department, archæologist, numismatist and historian; Mr. John Donald Pollock, Surgeon-Commander R.N.V.R. medical service during the War; Dr. A. N. Richards, professor of pharmacology in the University of Pennsylvania; The Hon. Lord St. Vigeans, formerly chairman of the Scottish Land Court.

DR. L. FARKAS, who has been working in the Department of Colloidal Science in the University of Cambridge for the last two years, has been appointed lecturer in physical chemistry and head of the new Department of Physical Chemistry in the Hebrew University, Jerusalem, Palestine.

THE University of Durham inaugurated in October 1924 a Department of Science, and a statistical summary of the work accomplished in it in the ensuing ten years 1924–34 has now been published. Its educational work has been mainly for the benefit of prospective school teachers, these numbering 220 out of a total of 304 students who entered for undergraduate courses, but a substantial volume of original work has been done. Excluding book reviews and other miscellaneous publications, original papers, including books, published from the Department between October 1924 and December 1934, numbered 118, of which a large proportion, 49, were concerned with geology, local or general. A distribution of undergraduate students in 1934 among subjects assigns to physics 47, geology 39, mathematics 36, chemistry 34, botany 22 and geography 4.

Science News a Century Ago

Improvements in Iron Manufacture

On March 16, 1835, Dr. Clark read a paper "On the Application of the Hot Air Blast in the Manufacture of Cast Iron", to the Royal Society of Edinburgh. After giving a general account of the manufacture of cast iron, he said that the method first suggested by Mr. Neilson of Glasgow and tried at the Clyde Iron Works consisted of previously heating the air thrown into the blast furnace. The method was found to produce a vast saving of fuel and of flux. During the experiments made in 1830, the air was heated to 300° F. In 1831, Mr. Dixon of the Calder Iron Works thought of substituting raw coal for the coke which had hitherto been employed for fuel, at the same time heating the air to 600° F. The result was that three times as much iron was now made by the use of a given weight of coal as formerly.

Geology of the Cordillera

On March 11, 1835, H.M.S. *Beagle* anchored again at Valparaiso, and a few days later Darwin set out to cross the Andes to Mendoza by the Portillo Pass. In his account of the journey, he recorded on March 19, 1835: "All the main valleys in the Cordillera are characterised by having, on both sides, a fringe or terrace of shingle and sand, rudely stratified and generally of considerable thickness. . . No one fact in the geology of South America interested me more than these terraces of rudely-stratified shingle. They precisely resemble in composition the matter which the torrents in each valley would deposit, if they were checked in their course by any cause, such as entering a lake or arm of the sea; but the torrents, instead of depositing matter, are now steadily at work wearing away both the solid rock and these alluvial deposits, along the whole line of every main valley and side valley. It is impossible here to give the reasons, but I am convinced that the shingle terraces were accumulated during the gradual elevation of the Cordillera, by the torrents delivering, at successive levels, their detritus on the beach heads of long narrow arms of the sea, first high up the valleys, then lower and lower down as the land slowly rose. If this be so, and I cannot doubt it, the grand and broken chain of the Cordillera, instead of having been suddenly thrown up, as was till lately the universal, and still is the common opinion of geologists, has been slowly upheaved in mass, in the same gradual manner as the coasts of the Atlantic and Pacific have risen within the recent period. A multitude of facts in the structure of the Cordillera on this view receive a simple explanation."

Investigations on Vesuvius

At the Royal Society on March 19, 1835, Daubeny read a paper entitled "Some account of the Eruption of Vesuvius, which occurred in the month of August 1834, extracted from the manuscript notes of the Cavaliere Monticelli, Foreign Associate of the Geological Society, and from other sources; together with a Statement of the Products of the Eruption, and of the Condition of the Volcano subsequently to it". After the eruption, the author had descended twice into the crater, which then presented a comparatively level surface, its sides consisting of strata of loose volcanic sand and rapilli, coated with incrustations of common salt, coloured red and yellow by peroxide of iron. The vapours which issued from the various parts of the surface, collected and condensed by means of an 'alembic' introduced into the ground, were found to consist principally of steam and muriatic acid, with only a slight trace of sulphurous or sulphuric acids. The author considered that carbonic acid was also exhaled, but neither nitrogen nor sulphuretted hydrogen appeared to form any part of the gas emitted.

The London and Greenwich Railway

In a note in its issue of March 21, 1835, the *Mechanics' Magazine*, referring to the London and Greenwich Railway, the first railway running out of London, said, "the Greenwich Railway will certainly not be ready to take passengers to the fair on Easter Monday, although according to some sanguine expectants, it was to be ready for that purpose two years ago. It is still progressing, however, and some of its arches have now made their appearance at the London Bridge end of the line, close to Tooley-street. It is understood that a locomotive will ply at Easter, for the conveyance of passengers on that part already completed; of course, such a trip will be taken more for the gratification of curiosity than for the sake of utility. A plan has been broached for erecting a landing place for steamers at Deptford, in connexion with the railway. . . The success of such a speculation, however, is problematical. In nearly the same time that it would take steam-vessel passengers to land at Deptford, and get seated 'all right' in the railway carriages, they might by going on in the steamer, be at the end of their voyage; and could the transference be effected with even instantaneous rapidity, the railway carriages could not land passengers in the city, as the steamers now do, but in Tooley-street, Southwark, a good quarter of a mile away." As originally planned, the railway had 878 arches, and alongside the line was to be a tree shaded road, a parade for invalids and children "incomparably superior to the boulevards of Paris".

Societies and Academies

LONDON

Royal Society, March 7. C. T. R. WILSON and J. G. WILSON. On the falling cloud-chamber and on a radial-expansion chamber. The advantages of removing a cloud-chamber from a confined space such as that between the poles of a magnet by letting it fall, and photographing the tracks while the chamber is falling freely, are pointed out. A new type of cloud-chamber, which has the form of a shallow cylinder with plane glass ends and in which the motion of the air during expansion is radial, gives good results. It is found, as anticipated, that dropping the cloud-chamber and photographing while it is falling freely enables undistorted track pictures to be obtained (by eliminating gravity) when the interval between expansion and illumination is prolonged to such an extent, that with the cloud-chamber stationary, distortion by convection currents has become serious. P. I. DEE and C. W. GILBERT. The transmutation of heavy hydrogen investigated by the cloud track method. The ${}_2He^3$ nuclei produced in the reaction

$${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$$

have been detected in the expansion chamber by passing a beam of artificially accelerated ${}_1H^2$ ions into a gas mixture containing heavy hydrogen. The range of this group of particles has been measured and is 4·3 ± 0·2 mm. for zero bombarding energy. The neutrons produced in the same bombardment have an energy of $1·8 \pm 0·2 \times 10^6$ electron volts. These results are in agreement with the application of the conservation of momentum to the process assumed. A value of 1·0080 ± 0·004 is thereby deduced for the mass of the neutron.

PARIS

Academy of Sciences, January 28 (*C.R.*, 200, 357–428). JEAN TILHO: Some geographical peculiarities of the new Franco-Italian frontier between French Equatorial Africa and the Tripolitaine. Suggestions that in drawing the new frontiers sufficient regard has not been paid to geographical details. LOUIS DE BROGLIE: A remark on the interaction between matter and the electromagnetic field. CHARLES ACHARD and MAURICE PIETTRE: Researches on the protein of the hepatic tissue. Description of results obtained by the application of a new process, in which the pulp mixed with water is projected in a very fine stream against a polished surface cooled to −30° C. WILLIAM BOWIE: The support given to geodesy by the Government of the United States of America. ALBERT FRANCIS BLAKESLEE was elected *Correspondant* for the Section of Botany, in succession to the late R. Chodat. MAURICE FRÉCHET: The general solution of Chapman's equation. JACQUES DELSARTE: Application of the theory of mean periodic functions to the solution of the equations of Fredholm-Nörlund. P. J. MYRBERG: The representation of automorph functions belonging to groups of genus zero. GÉRARD PETIAU: The matrices of the theory of the photon. PIERRE MASSÉ: Various problems on the limits of the theory of intumescences. DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The spectro-photometric study of the short wave-length radiation of some stars. A description of experiments carried out at the Jungfraujoch Observatory. Measurements were made mainly on stars of types *A* and *B* for wave-lengths between 4500 and 3100 A. CLAUDE CHARMETANT: The electrolysis of zinc chloride in solution in mixtures of water and ethyl alcohol. The effects of varying proportions of alcohol and of different current densities have been studied. PIERRE JACQUET: The mechanism of the action of certain colloids in electrolytic baths. PIERRE JACQUINOT: The fine structure of the components in the Paschen-Back effect in multiplets. ION I. AGARBICEANU: The magnetic weakening of the fluorescence of Te_2 and S_2. CHARLES DHÉRÉ and MLLE. ANNE RAFFY: The fluorescence spectra of rubene (tetraphenylrubene) in benzene solution and in the solid state. Two reproductions of spectrographs are given. R. AUDUBERT and C. REITHMULLER: The spectral sensibility of photo-electric counters. LÉONARD SOSNOWSKI: The artificial radio-activity excited in gold and the complexity of its radiation. F. FRANÇOIS: The system antimony iodide, potassium iodide, water. JEAN BUREAU: The diagram potassium nitrite—water. The hydrate $KNO_2, 0·5H_2O$. MARIO PICON: The action of heat on some metallic campho-carbonates. CLÉMENT DUVAL: Can cobalt have a co-ordination number eight? The author, repeating the experiments of K. Matsuno, has been unable to confirm his experimental results and regards his conclusions as doubtful. MARCEL MATHIEU: The structure of trinitrocellulose. Discussion based on X-ray measurements. L. PALFRAY and S. SABETAY: The application of the Cannizzaro reaction to the fatty and arylfatty series. ROBERT TRUFFAULT: The polymerisation of cyclohexene in the presence of phosphoric anhydride. CHARLES PRÉVOST: The synthesis of one of the dihydroanthranediols. JEAN GRARD: The nitration of starch. Nitrating starch by a modified method gave a product containing 11·5–12·5 per cent nitrogen. This is less stable than nitrocellulose and differs from the latter in its properties. PIERRE CHATELAIN: The measurement of the refractive indices of para-azoxyphenetol in the state of anisotropic liquid. HUBERT GARRIGUE: The radioactivity of air in the mountains. HENRI GESLIN and JEAN SERVY: An index characterising dryness from the agronomic point of view. W. KOPACZEWSKI: The jellying of proteins by acids. LAZARE SILBERSTEIN: The chemical composition of bone. The case of the femur of the horse. LUCIEN PLANTEFOL and GEORGES CHAMPETIER: The action of heavy water on the germination of pollen. Comparative study of the germination of pollen grains by ordinary and heavy water. There are marked differences, but heavy water cannot be regarded as toxic to the pollen.

CRACOW

Polish Academy of Science and Letters, January 7. W. JACYNA: Action at close quarters and action at a distance in the characteristic equation of thermodynamics. W. JACYNA: The principle of the predominating influence in the characteristic equation of thermodynamics. K. DZIEWONSKI and M. OTTO: Study on α-methylnaphthalene. MLLE. J. WOLOSZYNSKA: The algæ of the lakes and marshes of the Tatra. Two Gymnodinians of the lakes 'Morskie Oko' and 'Czarny Staw pod Rysami'. J. TUR: Researches on the embryonic neoplasmoids. L. W. WISNIEWSKI: *Cercaria dubia*, and its evolution in *Herpobdella atomaria*. ST. MARKOWSKI: The evolutive cycle of *Bothriocephalus scorpii*.

COPENHAGEN

Royal Danish Academy of Science and Letters, November 2. NIELS BOHR On the applicability and limitation of the methods of classical physics in the description of collision and radiation processes

November 30 L. KOLDERUP ROSENVINGE: Distribution of the Rhodophyceæ in Danish waters Statistical investigations on the distribution of the Danish Rhodophyceæ show that the number of species decreases greatly from the northern Kattegat to Bornholm The species dominant in the south, which are, however, common in the northern districts, decrease more rapidly, with the consequence that the northern species are more numerous than the southern in the intermediate zones ØJVIND WINGE: Experimental alteration of sex chromosomes into autosomes and vice versa, as illustrated by *Lebistes*. The common view concerning the distribution of the sex-determining elements in the sex chromosomes and the autosomes is incorrect Female, as well as male, genes are present in the autosomes, and by systematic selection of male or female autosomal genes the sex may be changed In the experimentally produced *Lebistes* race in which both sexes have XX, 50 per cent of each sex are born in the spring, while nearly 100 per cent of females are born during autumn and winter, the external conditions having some influence upon sex determination in this race Besides normal XX females and XY males, the following types have been produced XX males, YY females, and YY males By crossing the XX males to normal females, all the offspring will be female, while YY males give only male offspring when crossed to normal females XY females crossed to normal XY males give males and females in the proportion 3 : 1, as expected The male-determining element in the Y chromosome is at one end. The gene contents of the sex chromosomes have been partly mapped out.

WASHINGTON, D C.

National Academy of Sciences (*Proc*, 20, 601–681, Dec 15, 1934). T E STERNE The accuracy of least squares solutions (2) The standard deviation of the errors of linear equations of condition MARGARET B SILER: Chromosome numbers in certain Ricciaceæ. Two basic numbers are found, 8 and 9, these include one chromosome very much smaller than the remainder HENRY E MERRIAM and JOHN E. RUTZLER, JR Reversible coagulation in living tissue (13). Caffeine increases the reflex excitability of the central nervous system from above downwards, and it causes insomnia It can be counteracted by an appropriate dose of sodium rhodanate G A. LEBEDEFF: Genetics of hermaphroditism in *Drosophila virilis* The third chromosome recessive gene (intersex) causes reversion of homozygous females to sterile males. Modifiers determine the time when this gene becomes active and hence the degree of hermaphroditism C. W METZ and E H GAY: Organisation of salivary gland chromosomes in *Sciara* in relation to genes These chromosomes shows 'bands' or 'discs' causing striations similar to those observed in the salivary gland cells of Diptera The strain of *Sciara* used shows regularly one particular 'vesicle' extending only half-way round the chromosome. Observation of fixed and living material suggests that, in the region of this 'vesicle', the two component chromosomes are not fused to form a cylinder, but lie side by side The 'vesicles' or 'segments' of different regions differ slightly and seem to be the 'chromioles' thought by Belling to represent genes W E CASTLE Body size of reciprocal hybrids in rabbit crosses If chromosomal genes alone function in the genetic determination of body size, then reciprocal crosses between pure races of different size should give identical results In such crosses between a large and three smaller races of rabbits, the offspring of large female mated with small male are, however, significantly larger than those of small female crossed with large male CHESTER STOCK A Hypertragulid from the Sespe Uppermost Eocene, California W W COBLENTZ and R STAIR Ultra violet transmission changes in glass as a function of the wave-length of the radiation stimulus Soda lime-silica and soda silica glasses show stages in photo-chemical equilibrium which are different for each wave-length of homogeneous radiation to which the glass reacts, and the soda seems to be the sensitive constituent To attain each stage of equilibrium, transmission may increase or decrease, according to the history of the specimen For wave-length 254 $m\mu$ and shorter, depth of penetration is small, for wave-length 365 $m\mu$ and longer, penetration is deep The shortest and the longest wave lengths used had the greatest photo chemical effects, namely, in depreciating and appreciating respectively the transmission of a soda lime-silica glass J L SYNGE On the expansion or contraction of a symmetrical cloud under the influence of gravity. A discussion employing invariant equations consequent on the usual field equations JOSEPH HALL BODINE. To what extent is developmental block dependent upon the metabolic activity of the embryonic cell? By immersing grasshopper eggs showing developmental block in hypertonic balanced salt solutions, it is shown that the block is not primarily dependent on the general oxidative metabolism and indeed that the oxygen consumption rate itself is a result of the block SELIG HECHT A theoretical basis for intensity discrimination in vision Photo-reception requires (a) an inactive photo sensitive substance which absorbs light and is changed by it into an active substance responsible for the nerve impulse, and (b) a mechanism for maintaining the supply of sensitive substance Equations are developed describing such a photo chemical system, and they give curves which fit the experimental results for *Drosophila*, the bee, the clam and the human eye Contrary to earlier results, it is found, in accordance with this theory, that $\Delta I/I$ (where I is intensity), after decreasing rapidly with increase of I, reaches a constant low value and does not rise again after passing through a minimum J S NICHOLAS and DOROTHEA RUDNICK The development of rat embryos in tissue culture The medium used was heparinised rat plasma plus rat embryonic extract Embryos of presomite to early 5–7 somite stages were observed up to 72 hours after explantation Growth and differentiation occur, but in 48 hours are one half and three quarters respectively of that of controls L H KLEINHOLZ Eye-stalk hormone and the movement of distal retinal pigment in *Palæmonetes*. Eye-stalks of this shrimp stimulated by light secrete a hormone causing inward migration of distal pigment cells; no substance of opposite action appears in the dark, so that the outward movement of the pigment cells appears to be inherent in the pigment cells themselves. B KAUFMANN and

H. D. Ursell. The dissection of closed surfaces and the Phragmen-Brouwer-Alexandroff theorem. William W. Flexner and Madeline Levin. The intersection of arbitrary chains and its boundary. W. J. Trjitzinsky. The general case of linear integro-differential equations. John L. Vanderslice: Conformal tensor invariants. A. Adrian Albert: Involutorial simple algebras and real Reimann matrices.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, March 17

British Museum (Natural History), at 3 and 4.30.—M. Burton: "Myths of the Countryside".*

Monday, March 18

British Museum (Natural History), at 11.30.—Dr. Hugh Scott: "Insect Collecting in Abyssinia".*

British Psychological Society (Industrial Section), at 6.—Dr. Jose Germain: "Industrial Psychology in Spain".

Royal Geographical Society, at 8.30.—Lieut.-Col. R. B. Seymour Sewell: "The Floor of the Arabian Sea".

Tuesday, March 19

British Institute of Philosophy, at 8.15.—(at University College, Gower Street, London, W.C.1).—Sir Josiah Stamp: "Can Present Human Motives Work a Planned Society?".*

Royal Anthropological Institute, at 8.30.—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Film of "The Worora Tribe of N.W. Australia: Technology and Ceremonies", comments by Rev. J. R. B. Love.

"Stonehenge and its Problems", comments by Gerald Heard.

Wednesday, March 20

Royal Meteorological Society, at 7.30.—Dr. F. J. W. Whipple: "The Propagation of Sound to Great Distances" (G. J. Symons Memorial Lecture).

Royal Society of Arts, at 8.—Wing Commander T. R. Cave-Browne-Cave: "Exhaust Noise and the other Noises of Motor Transport".

Thursday, March 21

Chemical Society, at 8.—Discussion on "Recent Progress in the Chemistry of the Terpenes", to be opened by Prof. J. L. Simonsen.

Friday, March 22

Queen Mary College, at 5.30.—Prof. E. K. Rideal: "Some Problems in Surface Action".*

Institution of Professional Civil Servants, at 5.30.—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Prof. H. Levy: "Science and Social Responsibility".*

British Science Guild and the Geographical Association, at 7.30.—(at the College of Technology, Manchester).—Comm. L. C. Bernacchi: "Antarctic Exploration, Past and Present".*

Royal Institution, at 9.—Prof. B. Melvill Jones: "Speed".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Fourth International Congress for Applied Mechanics, Cambridge, England, July 3rd–9th, 1934. Pp. xviii+283. (Cambridge: Printed at the University Press.)

Technical Publications of the International Tin Research and Development Council. Series A, No. 7: The Determination of the Porosity of Tin Coatings on Steel. By D. J. Macnaughton, S. G. Clarke and J. C. Prytherch. Pp. 9+8 plates. Series A, No. 14: Tinplate, some Fundamental Considerations. By W. E. Hoare. Pp. 16+4 plates. Series D, No. 1: A Study of the Yellow Stain on Tinplates. By C. E. Bevnon and C. J. Leadbetter, under the supervision of Prof. C. A. Edwards. Pp. 11+4 plates. (London: International Tin Research and Development Council.)

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 19, 1934. Pp. 840. (London: Society of Chemical Industry.) 12s. 6d.; to Members, 7s. 6d.

College Hall, London (University of London). Fifty-second Annual Report, September 1st, 1933–August 31st, 1934. Pp. 48. (London: College Hall.)

OTHER COUNTRIES

New South Wales: Department of Mines: Geological Survey. Mineral Resources, No. 36: West Darling District, a Geological Reconnaissance with Special Reference to the Resources of Subsurface Water. By E. J. Kenny. Pp. 180+15 plates. (Sydney: Government Printer.) 6s.

Smithsonian Miscellaneous Collections. Vol. 92, No. 14: Archeological Investigations in the Bay Islands, Spanish Honduras. By William Duncan Strong. (Publication 3290.) Pp. vi+76+33 plates. (Washington, D.C.: Smithsonian Institution.)

India Meteorological Department. Scientific Notes, Vol. 5, No. 60: A Study of the Atmospheric Horizontal Visibility at Bangalore. By A. Ananthapadmanabha Rao. Pp. 141–157+3 plates. (Delhi: Manager of Publications.) 10 annas; 1s.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 51: The Chemistry of Australian Timbers, Part 4: A Study of the Lignin Determination, II. By W. E. Cohen. (Division of Forest Products, Technical Paper No. 14.) Pp. 20. (Melbourne: Government Printer.)

Transactions of the National Institute of Sciences of India. Vol. 1, No. 1: Physiology, Bionomics and Evolution of the Air-Breathing Fishes of India. By Dr. S. L. Hora. Pp. 16+1 plate. (Calcutta: National Institute of Sciences of India.)

U.S. Department of Agriculture. Technical Bulletin No. 455: The European Corn Borer and its Controlling Factors in the Orient. By Charles A. Clark. Pp. 38. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the Boston Society of Natural History. Vol. 40, No. 4: On the Habits and Distribution of Birds on the North Atlantic. By V. C. Wynne Edwards. Pp. 233–346+plates 3–5. (Boston, Mass.: Boston Society of Natural History.)

U.S. Department of the Interior: Office of Education. Bulletin, 1933, No. 2: Statistical Summary of Education, 1931–32. Prepared by Emery M. Foster. Pp. 12. 5 cents. Bulletin, 1934, No. 8: Supervision exercised by States over Privately Controlled Institutions of Higher Education. By John H. McNeely. Pp. v+64. 10 cents. (Washington, D.C.: Government Printing Office.)

Madras Fisheries Department. Administration Report for the Year 1933–34. By Dr. B. Sundara Raj. Pp. iii+83+3. (Madras: Government Press.) 12 annas.

Jac. Berzelius Brev. Utgivna av Kungl. Svenska Vetenskapsakademien genom H. G. Söderbaum. Supplement utgivet genom Arne Holmberg: Brev från Berzelius till Thomas Thomson och till Alexandre Brongniart. Pp. 24. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.)

Smithsonian Institution: Unites States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1934. Pp. iii+109. (Washington, D.C.: Government Printing Office.) 15 cents.

Smithsonian Miscellaneous Collections. Vol. 93, No. 2: Mud Shrimps of the Atlantic Coast of North America. By Waldo L. Schmitt. (Publication 3292.) Pp. 21+4 plates. Vol. 93, No. 5: Nomenclature of some Cambrian Trilobites. By Charles Elmer Resser. (Publication 3295.) Pp. 46. (Washington, D.C.: Smithsonian Institution.)

The Museum Journal. Vol. 24, No. 1: Beth-Shan, Earliest Pottery, by G. M. Fitzgerald; Tell Billa, First Assyrian Level, by Charles Bache. Pp. 52. (Philadelphia: University Museum.)

Field Museum of Natural History. Zoological Series, Vol. 18, No. 12: New Fishes obtained by the Crane Pacific Expedition. By Albert W. Herre. (Publication 335.) Pp. 381–438. (Chicago: Field Museum of Natural History.) 50 cents.

Bulletin of the American Museum of Natural History. Vol. 67, Article 9: Catalogue of Mineral Pseudomorphs in the American Museum. By Clifford Frondel. Pp. 389–426. (New York City.)

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 172: Vocational Teacher Training in the Industrial Field. Pp. v+32. 5 cents. Vocational Education Bulletin No. 178: Teaching Farm Credit. Pp. vii+43. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 83, No. 2978: American Muscoid Flies of the Genera Ceratomyiella and Paradidyma. By H. J. Reinhard. Pp. 9–43. (Washington, D.C.: Government Printing Office.)

The Medical and Scientific Archives of the Adelaide Hospital. No. 13 (for the Year 1933). Pp. 42. (Adelaide: Government Printer.)

Østers og østerkultur i Norge. Av Torbjørn Gaarder og Paul Bjerkan. (Utgitt med bidrag av Fiskeridirektoratet.) Pp. 96. (Bergen: A.-S. John Griegs Boktrykkeri.)

Bergens Museums Skrifter. Nr. 16: Norges Levermoser. Av R. Jørgensen. Pp. 344+25 charts. (Bergen: A.-S. John Griegs Boktrykkeri.)

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Co-operation of State and Industry in Scientific Research*

ONE of the most valuable features of the annual report issued by the Department of Scientific and Industrial Research is what may be termed the map of research throughout Great Britain which it provides, in addition to the many impressive illustrations contained in the report of the way in which scientific research serves both industrial and social needs This map of research is of special interest at the present time Not only does the report indicate the direction which research upon urgent problems as housing and building, road transport, fuel supply and the like is taking, but it also indicates, as few if any other public documents do, the manner in which the resources of the State and of industry are being mobilised for the support of such research

From its inception, the work of the Department has been conditioned by the support it receives from industry Grants to the research associations have largely been on a pound for pound basis with contributions from the industry, and a good deal of work has been undertaken on specific problems for which appropriate fees have been paid by the industry or firm concerned The report of the Advisory Council for the year 1933 34 pays special attention to the various problems of co-operation presented in the work of the Department and to the methods by which effective and sustained research on fundamental and long-range problems is to be encouraged

Research work of this type is encouraged by the Department in several ways In the first place, there is a system of research grants to students, a scheme by which the Department is brought in direct contact with some of the fundamental scientific work at the universities A major advantage of this method is the assistance afforded to promising students to complete their training by a course of post-graduate study and research, and it is accordingly of considerable significance in regard to the recruitment of scientific staff by industry

In the second place, under the research association scheme various problems of fundamental importance are being investigated, and it is with the object of encouraging such long-range investigations that the Advisory Council is recommending, where circumstances warrant it, and conditional upon support from the industry, substantial block grants for periods such as five years In this way, by stabilising the finances of the research associations, it is hoped to facilitate intelligent planning and prevent the crowding out of vitally important researches, which may not be immediately productive, by *ad hoc* inquiries

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* Department of Scientific and Industrial Research. Report for the Year 1933–34. (Cmd 4787) Pp iv+192. (London H.M Stationery Office, 1935) 3s. net.

It is not, of course, suggested that even this scale of operations is one with which the industries should be content, and the Advisory Council has indicated its readiness to encourage further expansion by grants based on income in excess of a specified figure up to a prescribed limit There are, however, practical as well as financial limits to the expansion of the work of a research association, and in the majority of industries it will probably be found that, while the research work carried out by individual firms tends to increase, the activities of the research association tend to be limited to the more fundamental problems and to problems which are of interest to other industries also

The size of the average industrial unit naturally has some bearing on the future and final functions of a research association, but even when an industry maintains numerous research departments in its individual units and when the invaluable educational work of the research association has been achieved, there should remain a well-defined field of activity for the association, resembling in some respects the field of activity of a number of the research boards of the Department at the present time

Apart altogether from the suitability or necessity of the research association scheme for every industry, there is a third way in which the Department encourages scientific and industrial research —in actual financial co-operation with industry The co-operation we are now discussing is distinct from those special investigations or tests which individual firms or organisations ask the Department to carry out in its research stations and notably at the National Physical Laboratory, as a repayment service The current report refers to the extensive use made of the facilities of the stations of the Department by industrial undertakings in this way, but we are now referring to the encouraging growth in the volume of work undertaken by the Department as a demonstration to industry of the value of co-operation in the conduct of researches or investigations which are either too expensive or too lengthy to be attempted save by some large industrial association or by a group of firms

The cost of researches of this type is largely defrayed by contributions made by the co-operating firms, either directly or through some industrial organisation, and the balance of the cost is provided by public funds The expenditure, in contrast to that on a research association, is directed to specific researches, and in this way are handled many problems needing attention which could not be dealt with through a research association As an example of this type of co-operation the current report cites the researches at the National Physical Laboratory for the practical development of steels for use at high temperatures, financed as to at least one half from funds raised by the British Electrical and Allied Industries Research Association and the British Iron and Steel Federation Other examples are to be found in the work of the Steel Structures Research Committee, and the investigations to discover British sources of materials which could be used in place of natural pozzolanas to increase the resistance of concretes and mortars to certain forms of chemical attack

That there is a definite field for this type of co-operative research, even when the industries concerned are run on scientific lines and are conducting independent research on an extensive scale, is indicated by the support of the investigations last mentioned by such firms as Imperial Chemical Industries, Ltd , the Anglo-Persian Oil Co , Ltd and the Associated Portland Cement Manufacturers, Ltd The unconditional cash contributions made to the general work of the Department in special fields by industrial firms or associations may be regarded as another indication of the way in which the Department is regarded by progressive industry as supplying the essential staff work of research in fields which are important to many industries but the particular concern of none

It is, of course, difficult to disentangle work of this type, which finds a permanent place in our national structure of research, from more educational work, which will become less and less necessary as a scientific outlook is developed in all sections of industry and the support of research on an adequate scale becomes general The encouraging fact that the current report is able to quote three examples of researches which during the year have been transferred to the supervision of industry on the ground that their value to industry has now been fully demonstrated, while illustrating the success of the educational work of the Department, should not be taken as evidence that the need for co-operation between industry and national research stations in this way will tend to disappear

There is a further aspect of the work of the Department which should not be overlooked Among the contributions received against the gross expenditure on the National Physical Laboratory, for example, are large sums from the Air Ministry and other Government departments As the report shows, the Department is responsible for a good deal of scientific work on problems put before it by various Departments of State.

The Advisory Council's report indicates, moreover, that the influence of the Department is not limited to securing industrial and departmental co-operation in research in Great Britain only In certain fields such as those of food investigation, both storage and transport, and timber research, it has from the start encouraged scientific co-operation with the Dominions overseas, and in many ways the resources of the Department are freely available for Dominion and Colonial Governments To this policy may be traced the considerable developments in research organisation in South Africa, Canada, Australia and India, and contributions amounting to nearly £10,000 which have been received from the Empire overseas indicate the way in which the value of this co-operation is appreciated Every effort is being made to secure scientific co-operation between workers at home and abroad so that ideas and results in parallel inquiries may be freely pooled

It is clear from this brief review of the essential functions of the Department that its work fills a definite and permanent place in our national research organisation The relative importance of the research associations and the research stations under the Department and of *ad hoc* investigations in co-operation with industry may vary as the work of encouraging a scientific outlook in industry and the prosecution of research on an adequate scale succeeds, but each has its own definite place in the national economy

What is equally clear from any survey of the activities of the Department is the uneven distribution of research through the industries of Great Britain While industries can be found where expenditure on research may approach in magnitude the whole budget of the Department, there are other industries the expenditure of which in this matter is grossly inadequate and out of all proportion with their expenditure on such matters as telephone or postage For many years yet, it is highly probable that by means of the research associations and in other ways the Department must continue its work of fostering the support of research by industry itself, both through the evidence afforded of the value of scientific research to industry in the past, in assisting the application of existing knowledge to industrial problems, and by encouraging the use of the scientific method in all branches of industrial activity

The fullest use cannot be made of the national structure of research, however adequate, unless a scientific outlook and the vigorous and continuous examination of manufacturing practice in the light of available technical knowledge are characteristic of industry everywhere The assertion of the Advisory Council in its report three years ago has lost not one whit of its force under the conditions obtaining to-day ' Scientific research has in the past made striking contributions to industrial progress and it will make them in the future But the nation which will enjoy the benefits of science in the day-to-day progress of its industries is the nation which habitually applies scientific method and scientific knowledge , and it is that nation which will be able to seize the more spectacular achievements of science in the industrial sphere"

Reviews

Viewpoint and Vision

New Pathways in Science. By Sir Arthur Eddington (Messenger Lectures, 1934.) Pp x+333+4 plates (Cambridge At the University Press, 1935) 10*s* 6*d*. net

THIS book is, from one point of view, a revision of the author's "The Nature of the Physical World" (1929); from another, it is a sequel thereto. The subjects treated are, in the main, the same, but the treatment is brought up to date and the underlying philosophy is re-presented so as to face more directly the attacks of criticism In a brief review, only passing mention can be made of the purely scientific aspects of the book, interesting though they are , the general outlook demands chief attention

The first thing that springs to notice is the extreme stability of the author's attitude His citadel has been attacked by men of science, philosophers of various schools, rationalists, religionists and nondescripts, and after making all due allowance for mutual cancellation in such a variety of onslaught, we should have thought that sufficient unanimity of direction remained to cause, if not a breach in the walls, at least a modification of the method of defence It is not so Whatever change appears is a development of physical or astronomical theory , the philosophy remains the same This raises an interesting problem How comes it that a man, undoubtedly of exceptional insight, of universal interests coupled with wide and varied knowledge, a master alike of the most abstract processes of generalisation and the minutest details of application, and one gifted with extreme facility and grace of expression—how comes it, we ask, that such a man, having reached deliberate and apparently final decisions on fundamental matters, should find himself either misunderstood or opposed by almost every contemporary thinker who has considered the same problems ? To this question the present book suggests a possible answer

We should perhaps have said 'answers', for there is a subsidiary reason , namely, the highly figurative language employed We are not insensitive to the charm of Sir Arthur's style—the music of the spheres is wonderful , but the words are a little indistinct We are carried on through image and metaphor and simile and anecdote by the most perfect of guides, and the experience is so delightful that we could scarcely wish it otherwise , but there are moments when we sigh for just one simple, dry-as-dust footnote to tell us what it all means His defence of this practice is that in non-technical books one should aim at using inexact language—a defence which might be less ineffective if he had anywhere expressed his philosophy except in such books In answer to a critic who pointed out that in "The Nature of the Physical World" the word 'space' occurs with four different meanings, he pleads that the word *has* those meanings—as though words had inherent meanings independent of the ideas they are to convey "We call it 'pain'," said the Frenchman , "We call it 'brot'," said the German , "We call it 'bread'," said the Englishman, "and it *is* bread "

This point is not so trivial as it may appear, for it exemplifies a very general characteristic which we believe lies close to the main source of Sir Arthur Eddington's nonconformity The late advances in physics which have greatly clarified the outlook of most philosophers of science with regard to fundamentals, seem to have led him into greater obscurity Accordingly he takes a viewpoint from which familiar distinctions are invisible and surface features have profound meaning We will try to make this clear.

In the nineteenth century the philosophical man of science, however obvious it seemed to him that his subjective experience was the source of all his knowledge, was forced by the character of the physics he professed to admit an objective external world of which his experience was only one aspect. That world was therefore at once the source and the creation of experience Thanks to relativity, this unsatisfactory position is now unnecessary We start with experience, pick out those elements which are common to all observers, represent them by concepts defined in such a way that, by the aid of whatever suitably defined subsidiary concepts are necessary, they relate together as many as possible of the common experiences, and the resulting logical network is the 'external world' In brief, we have all experience as our starting point, and a builder (reason) who incorporates as much experience as he can into the ever-growing structure of the physical world , that is all

Now how does Sir Arthur Eddington view the matter ? Instead of thus resolving the nineteenth century dilemma, he makes confusion worse confounded From his summary on pp 257–58 of the allegorical first chapter, we extract the following ordered set of independent entities —(i) consciousness , (ii) phenomena of observation , (iii) nerves , (iv) theoretical physics , (v) the basal entities of physics (electrons, etc) , (vi) the nature of the basal entities (which, however, plays no part in the drama, being 'essentially unknowable') With this extremely complicated machinery to manipulate, it is small wonder that he finds himself remote from ordinary thinkers their problems scarcely concern him—his seem remote from them He is like a man in Arizona who, looking horizontally at ground level, misses the Grand Canyon but sees an ant-track fundamentally cleaving the universe Let us see some examples of this anomalous valuation

Sir Arthur's attitude to the basal physical entities affords a conspicuous one Their degree and kind of 'reality', he tells us, are identical with those of sticks and stones He does not believe, however, "that the twoness of two electrons is a bit like the twoness of two apples", and while the preservation of individual existence by photons between emission and absorption "is a very obscure question" (p 38), he regarded, we recall, the similar question relative to the moon (p 226 of the earlier book) as meaningless These are not inadvertences , if they were we should be captious to mention them He would reaffirm these statements but declare that the differences in question were insignificant We are not surprised to find later (p. 226) that his search for a physical standard of length, "idealised, if you like, but not to the extent of having a different relationship to human experience from that which a physical object has", ends in the choice of "the radius of curvature of space-time". It is not asserted, be it noted, that this entity can ultimately be expressed in the same terms as a physical object, it has the same "relationship to human experience". If Dr. Johnson had only thought of kicking the radius of curvature of space-time, what a refutation of Berkeley we should have had!

The same characteristic appears in a very different setting in his treatment of the following problem, given as an example of a certain principle. "If A, B, C, D each speak the truth once in three times (independently), and A affirms that B denies that C declares that D is a liar, what is the probability that D was speaking the truth?" A solution is outlined which appears not to be self-consistent, but we need not consider the solution —it is the attitude to the question that concerns us. Let us, then, eliminate superfluities and restate the second datum as "A says that D lies". Sir Arthur's treatment effectively combines the knowledge of D's moral character with that of A's. But is it not clear that such combination is purely fictitious? From our knowledge of D the probability is $\frac{1}{3}$; from our (independent) knowledge of A it is $\frac{2}{3}$. The results are inconsistent because the data are independent, we are effectively defining probability in different ways. On form a certain horse becomes favourite at 5 : 1, his probability of success is $\frac{5}{6}$. Statistics show that the favourite wins, say, once in ten times, his probability of success is $\frac{1}{10}$. What meaning can there be in combining the two results? Yet such distinction of definition does not exist for Sir Arthur.

On the other hand, distinctions which to most of us seem trifling, or even fantastic, are for him vital. Perhaps the most striking instance is the question of the objectivity of "time's arrow". The whole trouble arises because Sir Arthur has more than one independent world, and he wants them to correspond. Hence, feeling time's progress in consciousness, he must seek its counterpart in the physical world. To realise the problem, he pictures a state in which immediate consciousness of earlier and later is lost and we must experiment to find whether we are getting older or younger. Abolition of memory is not what is supposed, for that would leave us without consciousness that time *could* go on: we must be aware that time has this property, but not know which way it goes. We must be reduced, in short, to a state of idiocy compared with which the mental outlook of Caliban would be clairvoyance.

It is not to be supposed, however, that the problem with which Sir Arthur grapples so manfully does not exist. It is certainly real, but how different it appears from a normal point of view! Since the external world is built out of experience but does not contain the whole of experience, the going-on of time may or may not be in it. We find on examination that it is, that is, phenomena in which it is an essential element belong to that part of our experience which we share with others. If ever progression were so cruel as to desert experience, it would go out of the physical world also: we should deal with it exactly as we have dealt with absolute motion. From this viewpoint the problem is simple, and there is no need to invent a Gilbertian situation to give it meaning.

The relevance of this for our purpose, however, is not that change of viewpoint simplifies the problem, but that it does not destroy it. For in this respect it agrees with all other such transformations in declaring that Sir Arthur has no hallucinations. He may miss distinctions which exist, he may magnify distinctions which are shallow, but he never sees distinctions which are not there. At the present time this has profound significance.

Sir Arthur has lately placed before the scientific world a theory connecting relativity with quantum mechanics. In common, we believe, with most, if not all, of our betters, we have failed to understand it, and the account in the present book does little to illumine the darkness. We live in the hope that it will ultimately be transformed to natural co-ordinates. Nevertheless, if we were forced to express an opinion on whether it represented one of the greatest advances of a generation or a piece of sheer illusion, we should unhesitatingly choose the former alternative. This decision would be made purely on external evidence. Sir Arthur's past record and his consistent freedom from delusions, combined with his conviction that he has really unearthed something fundamentally important (a conviction which, unless we are greatly mistaken, is at the opposite pole from that which proceeds from self-deception) are positive indications which seem to us to outweigh the purely negative evidence arising from his inability to make the theory comprehensible. Such evidence, indeed, is largely discounted by the consideration that one who looks at everything abnormally would scarcely be expected to describe, in terms intelligible to others, something which only he as yet sees. The question, of course, remains open, for such considerations as these are negligible compared with the evidence which the theory itself should yield; but while the theory yields nothing generally intelligible, they may at least serve to suggest an attitude towards it.

In the meantime, we can enjoy to the full the more familiar fare which the present book provides. It is unfortunate that Nature, having endowed a man with almost incomparable vision, should set him at an angle so widely divergent from that of other spectators of her drama. But science does wonders in these days, and who knows but that ere long mental distances will be traversed with as much ease as physical ones? With this prospect in view we hope that in six years time the paper of the present volume will not have become so yellow as that of "The Nature of the Physical World" such books are worthy of better incarnation HERBERT DINGLE.

Standardised Drugs

The British Pharmaceutical Codex, 1934: an Imperial Dispensatory for the Use of Medical Practitioners and Pharmacists Pp xxv+1768 (London · The Pharmaceutical Press, 1934) 35*s* net

THE materia medica in use throughout the British Empire can be divided into two groups, those admitted to, and those excluded from, the "British Pharmacopœia", 1932 The second group is, on the whole, the more interesting, if only for the reason that the pharmacopœial drugs should be approaching the stage at which there is little more that can be said about their nature, composition and therapeutic value, though this is obviously not the case with such drugs as ergot and digitalis, whilst the unofficial drugs at the worst are declining into objects of historical medical interest, and at the best may be destined to attain pharmacopœial eminence in due course, or may even be the harbingers of therapeutic revolutions

It was a public-spirited desire to provide authoritative information regarding this newer materia medica which led the Pharmaceutical Society to publish the first "Codex" in 1907 and to issue new editions in 1911, 1923 and 1934. Drugs steadily become more varied and more complex and, in preparing this fourth edition, it has been necessary to distribute the work among six committees of experts. The success with which the work of these committees has been blended into a harmonious whole is especially noticeable in the monographs on crude vegetable drugs, which are now brief but clear and well-balanced statements, giving all the information the practising pharmacist is likely to require In spite of the recent activity in the chemical examination of vegetable drugs there remain a surprisingly large number with ill-defined components, or of which the activity cannot yet be assigned to any definite constituent

Though the Food and Drugs (Adulteration) Act requires a drug to be of the nature and quality demanded by the purchaser, it provides no standard by which the quality is to be determined. In these circumstances, the "Pharmacopœia" has become a presumptive standard for each of the drugs recognised in it, and it is no doubt hoped that the "Codex" will gradually acquire a similar position for the extra-pharmacopœial drugs it describes Both the "Pharmacopœia" and the "Codex" are already accepted as legal standards in certain parts of the British Empire Much work has obviously been done by the expert committees in providing the new "Codex" with standards "which experience has shown to be desirable as criteria of purity" and which "may be attained without undue difficulty or expense".

There are numerous appendixes, and special mention may be made of those on the determination of foreign matter in powdered vegetable drugs, hydrogen ion concentration, colloidal solutions and sterilisation, all subjects of outstanding importance in modern pharmaceutical practice

The old "Pharmacological and Therapeutic Index" is replaced by a "Pharmacological Index" (Appendix xiii) divided into drugs arranged in accordance with (*a*) their pharmacological action, (*b*) their use for a specific effect in certain diseases, the latter including most of the modern drugs evolved by chemotherapeutic investigations, the recent contributions to vaccine and serum therapy and those due to biochemical work on vitamins, hormones, etc

The most casual perusal of the volume impresses the reader with the amount and variety of analytical work now required in the manufacture and control of the enormous number of drugs and chemicals used in medicine, and it is not surprising that the Council of the Pharmaceutical Society should have considered it necessary to institute a post-graduate diploma in pharmaceutical analysis, for which, according to the official *Journal*, the first examination has been held recently

The proofs have been read carefully, and there are very few printer's errors The paper and the type have been improved, and the book opens fully and remains open, a desirable and not too frequent characteristic of books which, like this one, are intended mainly for reference

T A. H

Vitalistic Biology and Education

Education and Biology. By J A. Lauwerys, with the assistance of F A. Baker. Pp xvi+207+4 plates. (London: Sands and Co, 1934.) 5*s*.

MANY thoughtful biologists, both in schools of various grades and in colleges and universities, are becoming increasingly disturbed in their minds concerning the relation of their teaching to the ideals and wider issues of education. This unease is not merely a state to be resolved by the more widely spread inclusion of biology in the curriculum, desirable though this be: it has its roots in questionings of the philosophic perspectives of the subject itself and its presentation to the pupil Mr Lauwerys attempts to clarify the situation by considering the general problem and its practical issues, and as he is lecturer in the methods of science at the London Institute of Education, is deeply interested and widely read in the philosophic aspects of science, and has come under the humane influence of Sir Percy Nunn, his book is of absorbing interest His point of view throughout is that biology possesses its own concepts, technique and methods; the biologist must perceive the living organism as a concrete sensual whole with time and space relations, he must interpret his observations and results in biological concepts, and he must formulate a vitalistic philosophy of biology using "dynamic type" as a central concept For the teaching biologist this would involve not the abandonment of the usual subject matter but a fundamental alteration in the usual mode of presentation.

The author first attempts to sketch out his own vitalistic philosophy of biology, proceeds to a consideration of certain difficult problems which all teachers must face, such as the treatment of sex and the 'doctrine of evolution', and then discusses the subject matter of the syllabus and actual methods of teaching The last chapter deals with the laboratory and practical part of the course and contains particular applications of the earlier discussions Appendixes consist of an interesting plan showing the interrelationships of topics, a number of examples worked out to show the application to particular subjects of the method of approach discussed in the text and, finally, a number of bibliographies containing startling sins of omission and commission

Biologists will gain if they accord the author a respectful interest, even if this is not always a sympathetic one, for he has something definite to say and says it unusually well Many biologists, however, may find their patience wearing thin when reading certain portions of chapter iii, especially the discussion on evolution, where the author, both in text and references, seems to know little or nothing of twentieth century work Further, in many places, he seems to be writing from the point of view of a particular religious denomination, but it is to be hoped that this will not obscure the reader's view since, in the wider reaches of education, religious influences are still of primary magnitude, and in the immediate issue the author's vitalistic approach and philosophic attitude have no necessary connexion with religious tenets The book is a sincere attempt to deal with a very difficult and urgent problem, and it merits serious consideration by all who are interested in the teaching of biology.

W. B. B.

Short Notices

Gmelins Handbuch der anorganischen Chemie Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. *System-Nummer 59*. *Eisen.* Teil A, Lieferung 6 Pp xxi+1167–1420. 41.50 gold marks Teil A, Lieferung 7. Pp xxvi+1421–1634 36 gold marks. (Berlin: Verlag Chemie G.m.b.H, 1934)

ALTHOUGH the definite compounds which iron forms with other elements comprise the subject-matter of vol. A on iron, many elements play such important parts in the chemistry of steel and cast-iron that it has been found advisable to deal separately with such associations of iron and non-metals as can conveniently be termed alloys. This plan has involved very little overlapping For example, whereas iron carbonyls are properly included amongst the compounds, iron carbide will be found in the present volume on account of its peculiar significance in relation to cast-iron and steel, and we find the phase-systems iron-sulphur, iron-selenium, iron-tellurium, iron-boron and iron-carbon successively described and illustrated with diagrams. Naturally greatest importance is attached to the last-named system. The iron-carbon diagram is set forth very clearly in the familiar compact form, but it has also been enlarged to cover two full pages in order to show the varying readings, sometimes amounting to more than 100° C, of numerous investigators This is followed by several pages of explanatory notes and references to the literature, so that an enormous amount of significant detail upon this very important and complex problem has been assembled in a fashion that should be invaluable to specialists The properties of iron carbide, which is so conspicuous a component of these mixtures, are then recorded in great detail in order to prepare the ground for the remaining sections, which deal with problems of solidification and crystallisation of molten steels and with special processes such as annealing, decarburisation, rolling, hardening, tempering and case-hardening.

The next part of vol A is an elaborate compilation of the magnetic and electrical properties of both pure iron and the commercial varieties. Among the topics discussed we find theories of magnetism, magnetic properties of the atom, magnetic intensity, permeability, hysteresis, etc., as well as electrical resistance, thermo-electric effects, dielectric constants and electrophotophoresis The literature of this section has been reviewed to June 1934, and a most useful feature in both parts is the incorporation in every section of a bibliography of general literature.

Über den Geschmackssinn der Biene: ein Beitrag zur vergleichenden Physiologie des Geschmacks. Von K. v Frisch (Zeitschrift für vergleichende Physiologie, herausgegeben von K. v. Frisch und A Kuhn, Band 21, Heft 1) Pp 156 (Berlin · Julius Springer, 1934.) 19 80 gold marks

PROF VON FRISCH'S studies on the senses of sight and smell in bees and on the means of communication between bee and bee in the hive are well known His earlier reports on the sense of taste are here presented in greater detail

The method used was to determine the 'threshold value' of solutions of sugars which were attractive to bees This value varied with the age of the bee and the availability of other sources of booty.

The number of sugars and allied compounds tested which are sweet to bees, is less than in the case of vertebrates Such substances as saccharin are either neutral or repellent An attempt was made to correlate chemical constitution with taste but without marked success The high concentration of sugars in their natural food has made bees relatively insensitive to sweet taste Conversely, those plants which have afforded the more profitable nectar of higher concentration have been more thoroughly pollinated, giving a bigger yield of seed

Substances distasteful to bees were tested in a solution of cane sugar of known attractiveness. The repellent action of acids did not depend solely on the titration acidity. The theory is advanced that weak acids, not being fully dissociated, have a reserve of hydrogen ions, which replace those used up in the taste process This makes them appear more effective than strong acids of the same hydrogen ion concentration. This phenomenon is more marked with higher concentrations of acid

The author concludes that bees can distinguish the four flavours, sweet, salt, acid and bitter D M.

Modern Acoustics By Dr. A H Davis Pp. xi + 345 (London G Bell and Sons, Ltd., 1934.) 26s. net

DR DAVIS'S treatise on modern acoustics has more than fulfilled the expectations aroused by the announcement of its early appearance The author has, very wisely, interpreted the title of the book strictly and, by saving space which might otherwise have been devoted to fundamental dynamical theory and to such classical problems as the vibrations of bars and strings, has been able to provide us with very full, lucid and well-documented accounts of the remarkable advances in acoustics made in the present generation. Modern methods of measurement of intensity, frequency and reverberation, the development of the notion of acoustical impedance, the ear and hearing, the acoustics of auditoriums, noise, its measurement and its suppression—this list by no means exhausts the topics treated in a volume which no advanced student of the science can afford to ignore.

The book, so far as the mathematical side is concerned, deals with results rather than with mathematical developments, and such matters as a detailed consideration of recent extensions of Rayleigh's principle scarcely fall within its purview. A. F.

The Flow of Water in Pipes, Sewers and Channels, over Weirs and off Catchments By G. B Williams. Pp. 76 (London . Chapman and Hall, Ltd , 1934) 10s 6d. net.

THE author of this publication, who was formerly Chief Engineer in the Public Health Department of the Government of Bengal, has embodied the results of his Indian experience and practice in diagrammatic form, using the coefficients which he has found most suitable for adoption with the classical formulæ of Manning and Kutter for discharges and velocity of flow in pipes and open channels, and the Francis formula for weirs There are 41 full-page diagrams, approximately 9 in by 6 in , dealing with this part of the subject, and thereafter five more diagrams relating to rainfall intensity, the relationship between rainfall and run-off and to flood discharges from catchment areas in India up to 1,000 square miles in extent

It is impracticable within the limits at disposal to describe in greater detail the information obtainable from the tables , they will undoubtedly be of service to the practising civil engineer who has to deal with questions of water supply, land drainage and sewage disposal, especially in circumstances similar to those in the author's experience The graphs are easy of interpretation and will save a great deal of calculation, being capable of supplying results for a wide range of conditions It has been the author's object to supply a need which he has felt for a tabular reference compilation of this kind not to be found in technical treatises on the subject generally B C

Das Brillenglas als optisches Instrument von den wissenschaftlichen Mitarbeitern an der Optischen Werkstätte von Carl Zeiss, Jena Von Prof. Dr Moritz von Rohr und Dr Hans Boegehold Mit einem Beitrage von Dr Hans Hartinger Völlige neubearbeitung des Buches "Die Brille als optisches Instrument" Pp. x + 281. (Berlin : Julius Springer, 1934) 25 80 gold marks.

PROF. VON ROHR has directed the Jena school of opticians for many years, and the treatise now before us is a completely revised edition of his book, "Die Brille als optisches Instrument". It is therefore of great interest to all interested in ophthalmic optics Apart from some introductory remarks on spectacle lenses for special purposes, the book is divided into four main parts. The first deals with anastigmatic lenses, some attention being paid to toric and to prismatic lenses. The second portion treats the problems of astigmatic lenses, and the third those of chromatic aberration. The mathematical treatment is easy to follow and graphs are effectively used. The last main section discusses problems of the alterations in field conditions produced by lenses.

Throughout the book the authors add delightful short sections on the historical aspects of the problems treated, and they fittingly conclude this excellent work with an account of the development of our knowledge of the spectacle lens and some notes on the training of opticians.

Possible Value of Inhalation of Carbon Dioxide in Climbing Great Altitudes

By SAMUEL B CHILDS, JR, HANNIBAL HAMLIN and PROF YANDELL HENDERSON, Laboratory of Applied Physiology, Yale University

MOUNTAIN sickness is a form of asphyxia due to the diminished partial pressure of oxygen at great altitudes The functional disturbances in this disorder are, however, not merely anoxial, but are largely the expression of a secondary and almost equally important deficiency of carbon dioxide in the blood and tissues Deficiency of oxygen induces hyperpnea and acapnia · that is, overbreathing and the resulting deficiency of carbon dioxide Acapnia in turn induces subnormal respiration and a continued or even increased deficiency of oxygen Haldane, Priestley and Douglas[1] demonstrated the correctness of Miescher's somewhat poetical formulation : "Over the oxygen supply of the body carbon dioxide spreads its protecting wings "[2] Henderson[3] confirmed the importance of the relation between the two gases in respiration when he found that it was possible to produce so great a deficiency of carbon dioxide by over-ventilation of the lungs that thereafter an animal may die of lack of oxygen with no effort to breathe

On Pike's Peak in 1911, Douglas, Haldane, Henderson and Schneider[4] made a number of observations on muscular work in which these relations were strikingly illustrated One of them was as follows · a member of the party whose respiratory centre was peculiarly sensitive (as indicated by the fact that he acclimatised more rapidly than any of the others) exercised by walking as rapidly as possible for a quarter of a mile up the cog railway, grade 1 in 5 While walking, he experienced an almost intolerable panting , but when he stopped to get his breath, he very quickly stopped breathing entirely for a few seconds, and then developed alternating hyperpneas and apneas Insufficiency of oxygen was clearly the condition inducing the excessive breathing and pumping out of carbon dioxide, and the consequent apnea. The apnea in turn intensified the anoxia and induced another period of overbreathing

As the work of climbing would not have been an excessive exercise for this individual at sea-level, it is probable that the amount of carbon dioxide produced was insufficient to maintain a continuance of vigorous breathing, except during the time that it was reinforced by acute oxygen deficiency.

The cause of the overbreathing was indicated by another observation. Merely squeezing a rather stiff rubber bulb with one hand as vigorously as possible, without other exercise, until the muscles of the forearm were tired, induced such excessive breathing that cessation of the manual activity was followed by apnea and then by alternating periods of overbreathing and apnea This observation accords with the classic investigations of Geppert and Zuntz[5] on animals It indicates, as they concluded, that some respiratory stimulant, other than carbon dioxide, is formed in vigorously active muscles, or under a deficiency of oxygen, and is carried by the blood to the respiratory centre, or the closely connected sinus caroticus For reasons that we will not now stop to discuss, we do not believe that this substance, 'respiratory X'[6], is lactic acid, but rather that it is some specific hormone that increases the sensitivity of the respiratory centre to carbon dioxide

Recently, Winterstein[7] has suggested that inhalation of a small amount of carbon dioxide might be helpful in maintaining respiration and promoting oxygen absorption at great altitudes In order to test this idea, two of the writers of this article, both vigorous young men, spent a few days on Pike's Peak during the summer of 1934

As the time on the Peak available for this investigation was short, the observations were confined to the subject of the acapnia which is the result of oxygen deficiency, and which in turn aggravates that deficiency For this purpose small cylinders were provided, charged with enough liquid carbon dioxide to form 400 litres of gas The flow of the gas was controlled and adjusted by a small, but accurate and light, reducing valve and flow gauge The whole apparatus* weighed only 4 kgm. and was carried at one side suspended by a strap across the opposite shoulder The flow was usually set at 2 litres per minute, and was conducted through a rubber tube to an open mask with wide holes to the outside through which the wearer breathed the outside air without the slightest impediment During expiration the gas was thus blown away and wasted , but during inspiration it mixed with the inspired air The amount of carbon dioxide inspired was therefore only about 1 litre per minute If the wearer of the apparatus breathed 50 litres of air per minute, the carbon dioxide was thus diluted to 2 per cent With a respiration of 20 litres per minute, the dilution would come to one in twenty or 5 per cent

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* We are much indebted to the Ohio Chemical and Manufacturing Company for placing this very efficient apparatus at our service It proved ideally convenient

The two members of our party had been on the Peak for only a couple of days, but were sufficiently acclimatised to be comfortable Three young men, who were employed in the hotel on the summit of the Peak (14,100 ft) and were fully acclimatised, also performed the tests Each of these five men made four experiments, wearing the apparatus and walking a distance of 250 yards up the cog railway, grade 1 in 5, in two minutes. The work amounted to lifting the man's body and the 8 lb. apparatus 150 ft vertically On one day the tests with inhalation of carbon dioxide were made first, and an hour later exactly the same exertions were made while wearing the apparatus with the gas shut off On the next day the control exertions were made first, and those with inhalation of carbon dioxide were made an hour later

The results on all five of the men were closely similar. None felt either the exertion of the respiratory strain to be at all increased by the inhalation , but rather the contrary All noted the greater regularity of their breathing with the gas on than with it turned off. This subjective evidence was also in accord with objective findings from pulse counts and measurements of arterial pressure made immediately after the climbs The average pulse rate was the same after the ten climbs in which carbon dioxide was inhaled than it was after the ten climbs without the inhalation : 126 heart beats per minute. Without the inhalation the average rise of systolic arterial pressure was 67 mm , namely 108–175 With the inhalation it was only 50 mm , namely, 110–160 Diastolic arterial pressure, instead of rising, was slightly lower after the exertion than before—lower by an average of only 1 mm without inhalation and 3 mm. with the inhalation The alveolar carbon dioxide was lowered 0 5 per cent in the control test without inhalation ; but was 0·5 per cent higher after the exertion than before when the inhalation was used.

These effects are not large, but on the whole the evidence indicates that the exertion was made with somewhat less strain on the heart and respiration with inhalation of carbon dioxide than without. The reason appears in the fact that excessive loss of carbon dioxide was prevented. On the contrary, the alveolar carbon dioxide was raised. The supply of oxygen was thus protected and its utilisation aided by the influence of the carbon dioxide upon the Bohr-Haldane[1] relations of the blood gases.

In addition to these experiments, observations were made upon thirty tourists who were more or less affected with mountain sickness and who, out of several hundred visitors to the Peak, submitted to be treated and examined. All had made the ascent either by the cog railway or by automobile. In most of these cases cyanosis or pallor, dizziness, headache and nausea had developed when they walked about on the summit or came into the warmer air of the lunch room. In extreme cases, periodic breathing, confusion, muscular cramps and twitchings, and low blood pressure or even fainting occurred before the inhalation was administered

The inhalation was usually continued for only 2–3 minutes at a time The effects were in most cases subjectively beneficial. None felt the worse for it The colour of their lips was distinctly improved Respiration was in all cases changed from irregular, or even intermittent, to a regular and deep rhythm, but was seldom increased in rate. Systolic arterial pressure was not altered significantly, that is, only from an average of 105 mm to 103 mm The average diastolic pressure, on the contrary, was raised from 62 mm. to 69 mm , while the pulse-rate was decreased from an average of 92 to 82 per minute Considering that these figures were the averages on thirty subjects, they are, we think, significant of distinct benefit from the inhalation

The only persons whose conditions changed disadvantageously were two men who had ascended the peak on foot, arriving in a state of exhaustion, who developed conditions verging on collapse just as the inhalation was started. Their condition appeared so serious that instead of continuance of inhalation, arrangements were made for them to be immediately conveyed down the mountain. It is probable that their collapse was due to their exhaustion and that it would have developed anyway, as is often the case, as soon as they stopped climbing. It seemed safer, however, not to continue the inhalation, lest it should be blamed for their subsequent condition.

Our conclusions are that, at least up to an altitude of 14,000 ft. (barometric pressure 450 mm) inhalation of a small amount of carbon dioxide with the inspired air is distinctly beneficial in protecting against both acapnia and anoxia during and after vigorous physical exertion. As the effects were even better on those who had made no great exertion, we suggest that such an inhalation might be of considerable value also for passengers travelling by air at altitudes up to at least 14,000 ft Tests at greater altitudes on mountaineers and aviators are deserving of trial For this purpose, carbon dioxide has one advantage over oxygen : much less is required.

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[1] Haldane, J S , "Respiration", Yale University Press, 1922

[2] Miescher-Rusch, *Arch. Physiol.*, 355 ; 1885

[3] Henderson, Y , *Amer J Physiol.*, 21, 142 , 1908

[4] Douglas, Haldane, Henderson and Schneider, *Phil. Trans Roy Soc.*, B, 203, 207 ; 1913

[5] Geppert and Zuntz, *Pflüger's Arch* , 42, 189 , 1888

[6] Henderson, Y., *Physiol. Rev* , 5, 131 , 1925 , and Henderson, Y , and Greenberg, *Amer J Physiol* , 107, 37 ; 1934

[7] Winterstein, H , *Acta Aerophysiologica*, 1, Fasc. 2, 3 ; 1934.

Light-Waves as Units of Length

By DR. W. EWART WILLIAMS, King's College, London

THE standard of length measurement in any age gives us a fairly true picture of the general requirements of the time. King David of Scotland (c. A.D. 1150) ordained that the Scotch inch should be the mean measure of the thumbs of three men, "an merkle man, an man of measurable stature and an lyttel man", the thumbs being measured at the root of the nail. The history of the transition to our present-day standards was admirably related by Sir Richard Glazebrook in his Guthrie lecture to the Physical Society in 1931.

For more than a century, scientific men have been attracted to the idea of establishing the unit of length on the basis of some natural standard, as in the famous dream of Arago[1], "une mesure susceptible d'être reproduite quand même des tremblements de terre, des cataclysmes épouvantables viendraient à bouleverser notre planète et à détruire les étalons prototypes gardés aux Archives". The metre was originally intended to be one millionth part of a meridional quadrant of the earth, and the yard, if ever lost, was, according to the Weights and Measures Act of 1824, to be replaced by reference to the length of a pendulum (in vacuum) beating seconds at sea-level in London. Various difficulties finally led to the adoption of purely arbitrary units, and the metre and yard became the distances between marks on bars kept at Sèvres in France and at the Standards Office of the Board of Trade in London.

The idea of employing a light-wave as the standard of length was frequently proposed during the nineteenth century. Clerk Maxwell[2], in an eloquent address to the British Association at Bradford in 1873, pointed out that: "Each molecule therefore throughout the universe bears impressed on it the stamp of a metric system as distinctly as does the metre of the Archives at Paris or the double royal cubit of the temple at Karnac". Pierce[3] in 1879 attempted a precision measurement of the wave-lengths of the sodium lines, and with improved diffraction gratings the work was repeated by Bell[4] in 1887. The first description of a method that would ensure sufficient accuracy was given by Michelson and Morley[5] in 1887 and in more detail in 1889.

With the assistance of Dr. Gould, the American representative on the newly-formed International Committee of Weights and Measures, Michelson[6] was able to use his new type of interferometer, and in collaboration with Benoit, succeeded in making a direct determination of the number of waves of the red radiation of cadmium contained in the metre. In the usual Michelson interferometer, the light first falls on a half-silvered mirror so that the reflected and transmitted beams, of approximately equal intensity, are mutually perpendicular. The beams are then reflected back on their own paths by two fully silvered mirrors. With equality of optical paths and a slight tilt of either mirror, white light fringes can be observed in the beam emerging from the semi-silvered plate.

For the purpose of the metre determination, one of the fully silvered mirrors was replaced by an 'étalon' consisting of two parallel mirrors, one above the other in a stair formation; nine such units, with mirror separations ranging from 0.39 mm. to 10 cm., were constructed so that the labour and uncertainty of counting a large number of fringes might be avoided. The exact details need not be entered into here, but it should be clearly emphasised that although only the number of fringes in the smallest unit had to be actually counted, the method was such that the number of wave-lengths in the (double) path of the largest étalon was obtained to within a few hundredths part of one fringe. A mark on this étalon was placed in line with one of the fiduciary marks of the working standard metre by means of a travelling microscope, and white light fringes were obtained in the upper étalon mirror by suitably adjusting the reference mirror of the interferometer. When the unit was moved until the fringes appeared in its lower mirror, it meant that the étalon had been displaced by exactly its own length; this procedure was repeated, in all ten times, so that any error in the determination of this basic étalon is increased tenfold. Finally, the small difference between the alignment of the second metre mark and the new position of the étalon mark is measured by means of a travelling micrometer. This distance, of the order of a few hundredths of a millimetre, is so small that any uncertainty in the previously known value of the wave-length can have no influence on the result. It should be mentioned that the working standard metre has also to be compared with the available national standards, and these in turn have been similarly compared with the prototype metre itself by means of travelling microscopes in an arrangement that is termed a line comparator.

The fringes given by a Michelson interferometer are invariably broad, however monochromatic the source may be; in effect, we have two virtual sources, so that the bright and dark portions have equal width.

Hamy[7] in 1897 discovered the important fact that multiple reflection made it possible to obtain considerably narrower fringes with a corresponding increase in the resolving power. He constructed an interferometer consisting of a thinly silvered plate mounted in front of, and parallel to, a fully silvered mirror. When the fringes are observed by transmission through two semi-silvered surfaces instead of by reflection, the arrangement constitutes the Fabry-Perot interferometer, which has found wide application in the study of the structure of spectral lines.

Benoit, Fabry and Perot[8] used the latter instrument as the basis of an entirely distinct method of standardising the metre in terms of wave-lengths. The order of interference of the circular fringe system of an étalon with a plate separation of approximately 6·25 cm was first determined by means of Benoit's fractional part method, since the wave-lengths of a number of lines were already known with sufficient accuracy for this purpose. This order of interference is the number of waves contained in the double path of the étalon.

The next step was to obtain the path difference (in wave-lengths) between a single reflection in a similar unit of twice its size, and a double reflection in the basic unit the value of which is already known. This was accomplished by arranging the units in line, so that a beam of white light could be passed through both and the well-known Brewster fringes obtained. The exact difference was found by introducing a previously calibrated wedge into the beam. The process was repeated with successively larger units until the 100 cm standard had been reached.

Instead of attempting to set the cross-wires of the microscope comparator on the silvered edges of the plates when comparing it with the working metre, the measurements were made to rulings on the edges of the plates close to the surface and similar in character to the marks on the metre. By means of a subsidiary experiment, probably the most ingenious and beautiful example of fine experimental work in the whole field of metrology, the correction factor, which is the total distance from these marks to the effective reflecting planes, was determined with the, greatest possible precision.

The now classical work of Benoit and his collaborators, completed in 1907, was generally considered to be so accurate that a further determination was felt to be unnecessary. The wave-length of the red radiation of cadmium then found has been accepted and still remains the spectroscopic standard of length of the scientific world.

As a step towards the eventual adoption of a wave-length as the fundamental unit of length, the International Committee of Weights and Measures[9] urged the various national laboratories to carry out similar investigations using their own national standards.

The first results were those of Watanabe and Imaizumi[10]. Their apparatus, constructed by Hilger, was almost identical with that of Benoit, Fabry and Perot. A difference of 0·002 A was initially observed between the values of the wave-length of the red line as determined from the two Japanese standards No. 10 and No. 20. Agreement was obtained when these prototypes were later compared with the International substandards at Sèvres, and fresh values were found for their exact individual length.

The results of a determination carried out at the Physikalische Technische Reichanstalt, Berlin, have been given by Kosters[11]. The details of the method have not yet been given, but presumably, in view of the earlier intercomparisons of the cadmium and krypton wave-lengths described by Weber and Lampe[12], the method is based on Kosters's application of the Twyman and Green[13] interferometer. This consists of a modification of the Michelson instrument, in which the straight localised fringes are observed by using a point source at the focus of a lens, the eye replacing the eyepiece of the telescope.

Sears and Barrell[14], of the Metrological Department of the National Physical Laboratory, have recently published the preliminary results of a systematic investigation of the problem extending over the last ten years. A description of the actual apparatus has been previously given[15]. As will be seen in a later section in which the various results are analysed, the work is of the greatest importance, and not only the authors but also the Laboratory and its directorate deserve to be congratulated on the initiation and planning of such a comprehensive programme, the first stage of which has been completed.

The authors have approached the problem from an entirely different angle; instead of setting themselves the problem of finding the number of waves contained in the metre, they have primarily determined the number contained in standard gauges of approximately one metre length. This they can find with an accuracy far exceeding that possible in a direct metre determination, so that the lengths of various other gauges (in terms of wave-lengths) can be ascertained with a precision hitherto considered impossible.

The first part of the method is basically that of Benoit, Fabry and Perot. The number of waves in a $\frac{1}{12}$ or a $\frac{1}{9}$ metre étalon is determined and the unit is used for direct comparison with a $\frac{1}{3}$ metre étalon by means of Brewster's fringes. The step-up of four or three times instead of the double step formerly used only involves a slight reduction in the clearness of the fringes The calibrated wedge is omitted and the exact multiple of optical paths is obtained by tilting the larger unit, a method due to Fabry and Buisson[16]

An X-section gauge, the ends of which are optically parallel, is mounted inside the third étalon, which has to be slightly longer than a metre in order to accommodate the metre gauge The Brewster fringes, given by three reflections in the intermediate standard and one in the larger unit, are observed in turn through each of the four channels or apertures formed by the X-section Thus the mean length A of the largest étalon in wave-length units becomes known The ends of the X-gauge do not touch the half-silvered étalon surfaces, the path differences B and C between the polished ends of the gauge and the silvered surfaces are determined by means of the circular Hamy fringes using Benoit's fractional part method The *optical* length of the gauge is therefore $A-B-C$ wave-lengths, and its mechanical length is also known provided the phase change on reflection at the gauge surfaces is determined by a subsidiary experiment This has been the primary purpose of the investigation

In order to obtain the number of waves in the metre, an auxiliary gauge approximately half an inch shorter is employed, together with two further half-inch end gauges at the centres of which fine lines are engraved If a half-inch gauge is wrung in contact with the auxiliary, a metre end standard is obtained which can be compared directly by interferometric methods with the X-section gauge When both blocks are wrung, one on each end of the auxiliary, the composite gauge forms a metre line standard which can be compared with the national standard in a line comparator. By taking observations with the blocks contacted in all possible ways, the effects of slight irregularities and differences in the blocks and their bisecting lines are eliminated

In the determination of the yard, the same étalons were used but the X- and the auxiliary gauges were 36 and 35.5 in respectively, so that the differences B and C were therefore much greater

Reference should also be made to the determination of the yard by Tutton[17] The method involved the actual counting of the number of fringes in a distance of $\frac{1}{16}$ in By an ingenious system of multiplication, the number of wave-lengths in the yard is determined by means of the Tutton wave-length comparator The basic unit is, however, too short to yield sufficiently accurate results This can be seen from the fact that temperature and pressure corrections for the basic unit are negligible, while they are applied to the greater lengths determined in terms of this unit On the other hand, the accuracy is considerably greater than the one part in fifty thousand which a casual inspection of the method seems to imply

For the sake of completeness, it might be recorded here that the writer[18] has proposed an entirely different method whereby the length of a metre gauge in the wave-lengths may be directly obtained from two observations A suitable reflection echelon is to be used and any errors due to optical multiplication are eliminated

[1] Arago, *Compt rend*, **69**, 426, 1869
[2] Clerk Maxwell, Rep Brit Assoc, Bradford, 1873
[3] Pierce, *Amer J Sci*, (3), **18**, 51, 1879
[4] Bell, *Phil Mag* (5), **23**, 265, 1887
[5] Michelson and Morley, *Phil Mag*, (5), **24**, 463, 1887
[6] Michelson and Benoit, *Trav Bur int Poids Mes*, **11**, 85, 1895
[7] Hamy, *Compt rend*, **125**, 1092, 1897
[8] Benoit, Fabry and Perot, *Trav Bur int Poids Mes*, **15**, 131, 1913
[9] *Proc-verb Com int Poids Mes*, p 67, 1923
[10] Watanabe and Imaizumi, *Proc Imp Acad Japan*, **4**, 350, 1928
[11] Kösters, *Phys Z*, **35**, 223, 1934
[12] Weber and Lampe *Phys Z*, **29**, 213, 1928
[13] Twyman and Green, Brit Pat 103832 *Phil Mag*, **35**, 49, 1918
[14] Sears and Barrell, *Phil Trans*, **233**, 143, 1934
[15] Sears and Barrell, *Phil Trans*, **231**, 75, 1932
[16] Fabry and Buisson, *J Phys*, **9** 189, 1919
[17] Tutton, *Phil Trans*, A, **230** 203 1931
[18] Williams, *Proc Phys Soc*, **45**, 699, 1933

(*To be continued*)

Obituary

PROF M. I. PUPIN

BY the death of Michael Idvorsky Pupin in New York on March 12 at the age of seventy-six years, we lose a mathematical physicist who has played an important part in engineering progress since the end of last century. The son of Serbian peasants, he emigrated at the age of sixteen years to New York, where he started to earn his living with only five cents in his pocket After many struggles, during which he supported himself by manual labour, he gained free tuition at the entrance examination to Columbia University in 1879 and distinguished himself by winning many prizes both for his studies and at athletics. After graduating, he became a naturalised citizen of the United States.

Pupin was the first holder of the John Tyndall fellowship at Columbia He elected to complete his training at Cambridge, England, being attracted by the prospect of studying under Clerk Maxwell and learning about his electromagnetic theory of light Marion Crawford, the novelist, gave him a letter of introduction to Oscar Browning of King's, but he was away on his summer vacation Pupin also had a letter of introduction to W D Niven, a tutor of Trinity College, who asked him what was his object in coming to Cambridge. He replied that he wanted to study under Clerk Maxwell, and was very surprised to learn that Maxwell had been dead for four years.

Before settling down at Cambridge, Pupin went to his native village, Idvor, in Hungary, to see his parents. On the way he stayed at Lucerne and was lucky enough to climb to the top of Titlis without accident. When he returned to Cambridge he entered King's College and studied mathematics under Routh. The present writer remembers seeing him there, and was impressed by his striking but un-English appearance. Although he enjoyed Routh's lectures tremendously, Pupin had gone to Cambridge to study physics, and in his interesting autobiography entitled "From Immigrant to Inventor", published in 1923, he says that he thought Prof. J. J. Thomson was too young to teach him much, and he was suspicious of Lord Rayleigh because of his title. Later on, he had the greatest admiration for them both.

After a two months holiday at Corrie in the Isle of Arran, where he read Faraday's "Experimental Researches", Pupin went to the University of Berlin and studied under Helmholtz and Kirchhoff, obtaining a Ph.D. degree. On his return to New York he was appointed to a teaching post at Columbia University, was afterwards appointed adjunct professor of mechanics, and then professor of electro-mechanics in 1901.

In 1896 Pupin discovered secondary X-ray radiation and invented in the same year means for short exposure X-ray photography, by interposing a fluorescent screen before the photographic plate. He invented also improvements in multiplex telegraphy and in methods of tuning for electrical resonance. His most important invention was in connexion with long-distance telephone communication. By means of inductance coils placed at pre-determined intervals of the transmitting line, he greatly extended its range. In almost every country in the world 'Pupin coils' are used, and the enormously rapid development of long-distance telephony during this century has been due mainly to the use of these coils. His first paper on the subject was published in the *Journal of the American Institution of Electrical Engineers* of March 22, 1899.

Although an American citizen, Pupin will long be remembered by thousands of his former countrymen in Serbia—now Yugoslavia. He founded the Serbian House in New York, and fathered and cared for thousands of poor immigrants. He gave princely contributions to the Serbian Red Cross, to refugee funds and to many others, and his ample fortune, made mainly from his tele-communication inventions, was sorely diminished. At Columbia University he was much esteemed and held in affection by the students. He was a member of the executive committee of the National Research Council, a fellow of many scientific societies and an honorary doctor of Columbia and Johns Hopkins Universities.

A. R.

PROF. H. A. GILES

WE regret to record the death on February 13 of Prof. H. A. Giles, formerly professor of Chinese in the University of Cambridge. Herbert Allen Giles was born on December 8, 1845, the son of Dr. John Allen Giles, well-known to many generations of students of the classics as a translator. He was educated at Charterhouse and in 1867 joined the consular service in China, being appointed to Tientsin after a probationary year at Peking. He retired from the service in 1893, returning to England, and in 1897 was appointed professor of Chinese at Cambridge. He held this chair until 1932 when he retired, having done much to foster the study of the Chinese language in the University, and secured its recognition in the 'Little go' in place of Latin or Greek for natives of Asia.

Giles laid the foundations of his scholarship in Chinese during his probationary year in Peking. Within a few years of his appointment to Tientsin, his knowledge of China had progressed so far as to enable him to write with authority on many sides of Chinese life and culture in the *Celestial Empire*. He had also begun work on his monumental Chinese-English dictionary. This indeed was to prove his *magnum opus*. It appeared in parts and in this form was completed in 1892. A new edition, revised and enlarged, appeared in 1912. It won him world-wide recognition as the first European authority on the Chinese language, and in 1911 was awarded the Prix St. Julien of the French Academy. Its pre-eminence in scholarship, however, should not be allowed to obscure the fact that Giles's knowledge of every side of Chinese life and culture was profound. Nowhere, perhaps, does this come out more clearly than in Giles's lighter works, and his "Strange Stories from a Chinese Studio" and "Quips from a Chinese Jest Book", no less informative than they are amusing, with their instructive notes and comments, might well serve as an introduction to most aspects of the many-sided Chinese mentality.

From 1870 onward, Giles was busily engaged, in such leisure as his consular duties afforded, in studying and in writing on the life, art, religion, language and history of the Chinese people. A long list of substantial and authoritative works stands to his credit, of which the best known, next to his dictionary, is "A Chinese Biographical Dictionary". His achievement was recognised by many honours, among which may be mentioned the Order of Chia Ho, conferred by the Chinese Government, the award of the triennial gold medal of the Royal Asiatic Society and honorary degrees from the Universities of Oxford and Aberdeen.

WE regret to announce the following deaths:

Prof. J. J. R. Macleod, F.R.S., regius professor of physiology in the University of Aberdeen, formerly professor of physiology in the University of Toronto, on March 16, aged fifty-eight years.

Prof. B. M. Wilson, professor of mathematics in University College, Dundee, formerly lecturer in pure mathematics in the University of Liverpool, on March 18, aged thirty-eight years.

Major-Gen. Sir Richard M. Ruck, of the Royal Engineers, known for his scientific work in submarine mining, chairman of Council of the Royal Aeronautical Society from 1912 until 1919, on March 18, aged eighty-three years.

News and Views

Centenary of the Geological Survey of Great Britain

THE Geological Survey of Great Britain is the oldest national geological survey in the world, having now been in active existence for a hundred years. It owes its inception to the private enterprise of the late Sir Henry Thomas De la Beche, who became its first director. Geological material was quickly accumulated and De la Beche was compelled to ask for museum accommodation. This was provided in a house in Craig's Court, Charing Cross, where it was opened to the public in 1841, as the Museum of Economic Geology. In 1851, the Museum was transferred to Jermyn Street, where it has continued until recently. For many years past, however, the space available has been inadequate, and it has been impossible to display to full advantage the very extensive collections of rocks, fossils and minerals in the possession of the Survey and Museum. In 1912, the Bell Committee recommended the transfer of the Museum and Survey to a site in South Kensington next to the Natural History Museum, but no action was taken until the Museums Commission met in 1927. The Government then agreed to the transfer, and the new building was completed by H.M. Office of Works in 1933. Occupation by the Geological Survey was, however, delayed by its utilisation as the meeting place of the World Economic Conference, 1933.

Opening of the New Museum of Practical Geology

IT is now announced that the new Museum of Practical Geology will be formally opened next July. Advantage has been taken of this to arrange a joint celebration of the centenary of the Geological Survey and the opening of the new Museum. In the new Museum at South Kensington ample accommodation has been provided to display the exhibits in a building specially designed to meet modern museum requirements. New material has been acquired from many sources and the extent and scope of the exhibits has been enlarged. For the past three or four years, geologists of the Survey and Museum have been mainly engaged in rearranging and bringing up to date the collections, their normal field work being subordinated to the needs of the Museum. At the back of the Museum new offices have been provided for the Geological Survey, together with modern laboratories for the prosecution of petrological and mineralogical research. Enlarged accommodation has been provided for the Library and collection of maps which, as in the past, will be available for consultation by the public. The Museum is to be opened by the Duke of York on July 3. On July 4 there will be a morning reception of delegates to the Centenary, followed by an address by the Director of the Survey on the history and functions of the Geological Survey of Great Britain. On the evening of July 4 there will be an evening reception by H.M. Government. Excursions to several of the classic areas of British geology follow immediately after the meetings. It is expected that a large and representative gathering of geologists from all parts of the world will be present for the celebration.

Dr. J. Chadwick, F.R.S.

DR. JAMES CHADWICK, fellow of Caius College, Cambridge, and assistant director of research in the Cavendish Laboratory, has been appointed to the Lyon Jones chair of physics in the University of Liverpool as from October 1 next, in succession to Prof. L. R. Wilberforce, who retires at the end of the present session. Dr. Chadwick is one of the most distinguished of the younger physicists in Great Britain. His early work on α-, β- and γ-radiation led to the experimental proof of Moseley's deduction that the charge on the nucleus was equal to the atomic number. Then, in association with Lord Rutherford, he carried out investigations on the anomalous scattering of α particles by light elements, which gave information on the size and structure of the nucleus of the atom, while another line of work demonstrated the artificial transmutation of certain lighter elements by α-particle bombardment. Improvements in the technique of counting such particles led to the discovery of definite nuclear α particle and proton levels. The obscure effects observed by M. and Mme. Curie-Joliot when beryllium was bombarded with α-particles were investigated by Dr. Chadwick, and immediately he recognised that they could be explained by assuming the ejection of a particle having mass but no charge. This assumption he quickly proved in a brilliant series of experiments, and a new elementary particle, the neutron, which has proved of wide importance in investigations on atomic structure, was made available to the physicist. The value and originality of Dr. Chadwick's work has been recognised by his election to a fellowship of the Royal Society, by the award of the Hughes Medal of the Society in 1932 and other distinctions.

Racial History of Britain

A LETTER to *The Times* of March 13 puts forward on behalf of the Royal Anthropological Institute proposals for a comprehensive survey of the racial history and physical constitution of the inhabitants of Britain—a matter in which action is long overdue. It is a remarkable fact, and one which was not generally appreciated until necessity arose during the War, that so little should be known of the physical characters of the British population as a whole. The racial character of the British peoples in prehistoric and early historic times, as preserved in skeletal remains in museums, has received attention from time to time, but piecemeal; and more or less extended investigations of the present population have been carried out in parts of Scotland, Wales, England and Ireland; but no organised attempt has been made to correlate this material or to extend it systematically. The proposals now put forward provide for both the examination of the skeletal material preserved in museums and anatomical collections and the measurement by trained observers of groups of the existing population all over the country Arrangements will also be made for the reduction and digestion of the material when collected, and for its publication

THE projected survey is an object which is deserving of strong public support Not only will the results be of the greatest scientific importance, as they will fill a gap in our knowledge of the composition of the British people which is much to be deplored, but they will also afford data of great significance, and from some points of view essential, in the consideration of a number of social and medical problems The survey will involve expenditure on instruments, travelling for purposes of observation and publication, towards which contributions are invited from the public in an appeal supported by, among other signatories, Lord Onslow, Lord Raglan, Lord Meston, Sir Richard Gregory, Sir Henry Wellcome and the Rev Edwin Smith, president of the Royal Anthropological Institute Contributions should be addressed to the Treasurer, Royal Anthropological Institute, 52 Upper Bedford Place, London W C 1

Expedition to New Guinea

PLANS for the exploration of the country in the neighbourhood of the Sepik River in the mandated territory of New Guinea, which have been in preparation for some time, are now approaching completion , and Mr G M Dyott, the leader, will leave shortly with two other members of the expedition for Australia, where he will be joined at Sydney by Mr H L Williams, the Australian anthropologist, who will complete the personnel of the party For some time past, the exploration of the Sepik River country has been an object of ambition of anthropologists and geographers alike The greater part of it is entirely unknown Last year, Mr E. W P Chinnery, in the course of an official tour of duty as Government anthropologist, penetrated to the eastern boundary of the unknown territory He reached the summit of Mount Hagen, and in his reports records how from a lofty plateau there he was able to look out over this country

MR. CHINNERY came into touch with hitherto undescribed peoples having many remarkable features in their culture, who were still living in the stone age (see NATURE, **134**, 328 ; 1934). In the account of his experience which he has since published, he describes signs of occupation in the unvisited tableland below, which point to a system of cultivation differing from anything previously recorded in New Guinea. Mr. Dyott's expedition, in addition to making a plane-table survey of the country traversed, will devote special attention to the culture of the peoples in the Sepik area It is also hoped to obtain conclusive evidence of the existence of the so-called 'devil-pig', a cloven-footed graminivorous animal, of which Mr. Monckton, formerly a resident magistrate in New Guinea, claimed to have observed the tracks, but of which knowledge otherwise rests on the report of the Papuans They fear it greatly The expedition is supported by the Australian Commonwealth Government and the Royal Geographical Society The collections which the expedition hopes to make will be divided between the Pitt Rivers Museum, Oxford, and certain institutions in Australia

Vertical Take-off with the Autogiro

SEÑOR DE LA CIERVA, lecturing before the Royal Aeronautical Society on March 15, made the first public announcement of the fact that he has produced a type of his autogiro that has achieved direct lift off the ground without any forward run This was shown by the exhibition of cinema films in which the machine was seen to rise without displacing chocks placed in front of the wheels Combined with its already proved ability of alighting with a practically negligible run, this makes it possible to visualise aircraft of this type operating from aerodromes of much smaller area, and less carefully kept surface, than hitherto Sea going operations, either from rough water or ship decks, are also facilitated by the absence of the need of horizontal run

THE combination of vertical lift followed by horizontal flight at the desired instant is attained by altering the pitch angle of the horizontal rotating lifting surfaces of the autogiro. These are set at the angle of no lift while the rotor is speeded up by a torque applied from the engine When the speed of rotation is considerably greater than that necessary for normal horizontal flight, the rotating mechanism is declutched, and simultaneously the angle of the surfaces is set to that for high lift Thus a lift in excess of the weight of the machine is created, and it rises When this impulse is expended, the machine would normally begin to descend, but in the meantime the full engine power has been changed back to the normal airscrew, and a thrust sufficient for horizontal flight is operating. This takes charge and the machine continues in horizontal or normal climbing flight at the will of the pilot The machine appears to leap only three or four feet in the films shown. Señor Cierva suggests that while jumps of the order of 60–100 ft are theoretically possible without needing prohibitive accelerations, an initial height of about 20 ft is all that practical considerations demand.

Television

THE recent publication of the report of the Postmaster-General's Committee on Television has aroused considerable interest in this subject not only among those technically interested in radio communication and broadcasting, but also among the general public, who now definitely envisage the prospect of being able to 'look' as well as 'listen' This interest has naturally given rise to a demand for literature, both technical and popular, on the subject. During the past year or so, however, progress in the technique of television at both the transmitting and receiving end has been so rapid that most of the books at present available are useful only in explaining the fundamental principles of television or of illustrating the historical development of the subject, which dates back some sixty years. With the object of temporarily filling this gap in the literature, the issue of the *Wireless World* of March 8 incorporated as a supplement a "Television Guide", comprising a 30-page booklet giving a simple explanation of the subject adequately illustrated by diagrams and photographs. This guide assumes a knowledge of electricity and the principles of radio communication on the part of the reader; the principles involved in television are clearly explained, together with the use and limitations of mechanical scanning systems. The manner in which the cathode ray oscillograph tube has been introduced into the art is described, with the resulting accelerated progress towards high definition television. The most recent developments of picture transmission technique are dealt with, including Zworykin's iconoscope and Farnsworth's image dissector as alternative scanning systems, and the use of the intermediate cinematograph film for the broadcasting of current events. The trend of this supplement to the *Wireless World* is definitely to explain the principles of the subject to the future owner of a television receiver, and as such, it may be said to form a useful appendix to the report of the Postmaster General's Committee.

Safe Passing Speeds for Motor-Cars

EVERY driver of a motor-car who desires to pass another car going in the same direction has to consider the problem of whether it is possible or not. Apart from the question of whether there is another car coming round the bend of the road in the opposite direction, he has to consider whether there is sufficient clear space ahead. According to a Science Service message, Dr. H. C. Dickinson, of the U.S. Bureau of Standards, has completed tests to find out how much clear space is necessary. Assuming a speed limit of 45 miles an hour and that cars travelling 50 miles an hour are tolerated, he finds that a distance of 900 ft. is required for safe clearance. The time required to pass on a level road depends only on their relative speed of five miles an hour, and is nearly six seconds. If the vehicle ahead is moving at 20 miles an hour the distance required is 650 ft., 200 ft. being required for the actual passing and 450 ft. being the necessary allowance for a car approaching at 50 miles an hour. The Highway Research Board of the U.S. National Research Council points out that, considering the number of roads in the country where clear stretches of 900 ft. are rare, there is often a serious risk when passing another car at high speed. In mountainous country, winding and hilly roads would come under this category. Dr. Dickinson's figures apply to a car passing only one car ahead; when long lines of cars 'pile up' on the road, greater distances are required for safe passing.

Library of the University of the Witwatersrand

THE University of the Witwatersrand was the scene of a disastrous fire three years ago, when the greater part of its library, including the Gubbins and the Hoernle anthropological collections, was destroyed. Appeals for help led to a very substantial measure of replacement, gratefully acknowledged by the University in a letter to the Appeal Committee in London, which has now issued its final report. In this, the chairman, Sir Frank Heath, observes that, while it is impossible to mention individually all the contributors, including learned, technical and scientific societies in England and America, universities and colleges throughout the British Isles and Canada, industrial firms, industrial research associations, British Government departments and the leading missionary societies having stations in South Africa, very special thanks are due to the British Association, the London School of Economics and Imperial Chemical Industries, Ltd. New College, Oxford, and the Imperial College of Science and Technology helped to defray expenses of collection, packing, transportation and insurance. The Union Castle Steamship Co. undertook the transport of books at a discount of 50 per cent on the ordinary freight charges, and the High Commissioner for the Union of South Africa lent an office rent free. The Universities Bureau of the British Empire placed its council room at the disposal of the Committee for its meetings. Besides books and manuscripts, a large quantity of pictures, coins, etc., was collected which will form the nucleus of a Johannesburg municipal museum. Some 32,000 volumes in all were dispatched by the Committee.

A Giant Tortoise

A FINE specimen of Porter's black tortoise (*Testudo nigrita*) has just been added to the Tortoise House of the Gardens of the Zoological Society of London. This is one of several species attaining a relatively gigantic size, which, a hundred and fifty years ago, swarmed in the Galapagos Islands, the Mascarene Islands, the Aldabras and the Seychelles. Then they attracted the attention of mariners, who forthwith began to visit these islands and carry away their victims by the boat load. Exploitation of this kind, whether of tortoises or whales, inevitably ends in extermination. On only a very few of these islands are any survivors to be found to-day. But it fortunately happened that many species were taken to other islands where they bred. This was the case with the species which has just come to the Zoo. For Capt. Porter, on his voyage from the Galapagos, in 1813, distributed several young tortoises from his stock among the chiefs of the Fiji Islands. Many of these escaped, and bred there. The great size of these animals is shown by the fact that the shell of the various species ranged from three to six and a half feet along the curve. Until its death, a few years ago, the largest living tortoise known was owned by Lord Rothschild. This was a specimen of *Testudo daudini*, of the South Island of Aldabra, taken, with six others, in 1895. The length of the shell was 55 in., or 67½ in. over the curve. The total weight was 560 lb. But even this was a mere pigmy compared with the extinct fossil tortoise (*Colossochelys atlas*) from the Lower Pliocene of the Siwalik Hills, India, which had a shell eight feet in length

Leukon Synthetic Resin

A NEW synthetic resin known as 'Leukon' was exhibited in granular thermo-plastic moulding form at the British Industries Fair by Imperial Chemical Industries, Ltd. The main physical properties of the material are stated to be as follows: density 1·2 at 20° C., impact strength 4 kgm cm. (Charpy units), tensile strength up to 10,000 lb. per sq. in., cross breaking strength 80/85 lb. cantilever, Young's modulus 227 tons per sq. in. The material flows before breakdown under high pressure. As regards the chemical properties of the material, it is said to be insoluble in water, alcohol and aqueous media, to be unaffected by acids or alkalies up to concentrations of 40 per cent in the case of sulphuric acid and caustic soda at atmospheric temperature, and to be unaffected by many high boiling organic esters. It is soluble in certain of its forms in a number of organic solvents, including acetone, chlorinated hydrocarbons and benzene. The material machines easily, can be die-stamped at 120°–140°, has very good insulating properties and low thermal conductivity. A property which is emphasised is the capacity of the material for colour, in transparent, translucent or opaque forms.

The Prehistoric Society of East Anglia

AT the recent annual meeting of the Prehistoric Society of East Anglia, held at the Norwich Castle Museum, it was resolved that in future the title of the Society shall be "The Prehistoric Society". Dr. J. G. D. Clark, in proposing the change, directed attention to the fact that the Society is no longer predominantly East Anglian either in membership or scope of work, and emphasised the point that the recognition of the Prehistoric Society as the only society operating on a national basis exclusively in the sphere of prehistoric archæology will be a contribution towards the much-desired rationalisation of the subject in Great Britain. The Prehistoric Society of East Anglia was founded in 1908 by the late Dr. Allen Sturge and the late W. G. Clark of Norwich. From very small beginnings it has grown until the membership now approaches 400 and includes the leading prehistorians in this and many other countries. Prof. L'Abbé Henri Breuil, the retiring president, is succeeded by Prof. V. Gordon Childe, with Mr. M. C. Burkitt as vice-president, Dr. J. G. D. Clark as editor and Mr. G. Maynard, curator of the Ipswich Museum, as honorary secretary.

The Philosophy of Sir James Jeans

IN the December number of *Adult Education*, Prof. L. Susan Stebbing subjects Sir James Jeans's recent presidential address to the British Association to searching criticism. She complains that he has rated the intelligence of his hearers and readers too low by presenting them with contradictory statements concerning Nature, space and time, and knowledge. Some of the questions raised were referred to in our leading article on the address which was published in NATURE of September 8 last, but Prof. Stebbing makes no attempt to penetrate to the vital ideas which were expressed, however imperfectly, by Sir James Jeans; she contents herself with pointing out the imperfections. As destructive criticism, the paper is of value, though, in the absence of counter-balancing constructive thought, it achieves less than its full potentialities. Prof. Stebbing fortunately does not make the common error of supposing that a single statement, by however distinguished a physicist, represents the unanimous view of 'physics'. "The point to be maintained here," she says, "is that these cloudy speculations cannot properly be regarded as 'philosophical implications' of the new 'physics'." This goes far to justify what might otherwise be construed as a philosopher's attack on the philosophical tendencies of modern physics.

Biology, a new Journal

WITH the object of helping teachers of biology in different types of schools at home and abroad, the British Social Hygiene Council has launched a new journal, *Biology*. It is hoped that the magazine will "serve as a medium for the interchange of ideas and information on practical and pioneer ventures in biology teaching". The scope of *Biology* is suggested by the articles in the first number. They include one advocating microscope work, dissection and physiology of growth and development in elementary biology teaching, another describing the methods in use in African dependencies. More general articles deal with plant communities and the school, the value of the micro-projector, biological activities out of school, and biology and general science in the First School Examination. The hesitation and delay in the introduction of biological teaching in schools throughout Great Britain is due largely to the indefiniteness of the subject's boundaries, and the lack of well organised graded courses of fairly definite content. If *Biology* can lead to the development of such courses by pooling information, it will be performing great service to the science of life.

Research on Causes of Blindness

MR. WILLIAM H. ROSS, chairman of the Distillers' Company, Ltd., who is himself totally blind, has recently given £40,000 to establish in Edinburgh an organisation "with the object of investigating the origin and causes of blindness, and utilising the results of such investigation towards its prevention and cure". The income from the money will be applied partly to research work on blindness, and partly to practical measures for its prevention and for the preservation of sight. The chairman of the trustees is Dr. Arthur H. H. Sinclair, president of the Royal College of Surgeons of Edinburgh.

New Australian Research Laboratories

Two new research laboratories are to be built for the Commonwealth Council for Scientific and Industrial Research, using money voted for relief of unemployment. One, at a cost of £6,000, will replace an existing small building at the Council's viticultural research station near Mildura on the River Murray, where investigations into problems of the dried grape fruits industry have been in progress for many years. The other will house the Forest Products Division, which hitherto has carried on in temporary quarters in Melbourne The new laboratory, to cost £25,000, will be in the midst of the city's timber yards, and this should mean decided increase in the practical effectiveness of the Division's work

Geographical Association

THE Spring Conference of the Geographical Association will be held at University College, Nottingham, on April 26–29 The meeting will include, in addition to several lectures and discussions, a long excursion to Southwell and Ollerton and visits to the tobacco factory of Messrs J Player and Sons, the hosiery factory of Messrs J B Lewis and Sons, and Messrs Boots new chemical factory Members will be accommodated as far as possible in the Hugh Stewart Hall of Residence Applications for accommodation and attendance at excursions should be made, before April 6, to Mr N V Scarfe, University College, University Park, Nottingham

Astronomical Exhibition in Paris

AT the next General Assembly of the International Astronomical Union, to be held at Paris on July 10–17, the French National Committee of Astronomy is arranging an exhibition of astronomical documents and apparatus, to exhibit the principles and the details of application of the methods of observation employed The examination of actual instruments shows better than any description how they are applied, while original negatives or positives on glass will enable the quality of the results obtained to be judged The exhibition will enable astronomers to examine the documents serving as the foundation of the astronomical discoveries of the present century It is particularly hoped that auxiliary apparatus and accessory contrivances of all kinds will be exhibited by observatories and instrument makers such instruments are micrometers, chronographs, photometers, spectrographs, driving motors, observing sheds and seats, abacuses, numerical tables and calculating machines Inquiries can be addressed to M le Comte de la Baume Pluvinel or to Prof C Fabry at the Paris Observatory

Sixth International Congress for Scientific Management

THE Sixth International Congress for Scientific Management, the first congress of its kind to be held in Great Britain, will take place on July 15 20 and will be opened by its patron, the Prince of Wales It will discuss commercial, agricultural and domestic problems and how far the adoption of the most scientific principles of management has facilitated their solution. Some three hundred chairmen, managing directors and professional and scientific men have so far enrolled, and the standard of the papers received from all parts of the world is most encouraging The organisation of the Congress is in the hands of a Council convened by the Federation of British Industries. Subjects to be discussed include: manufacturing, distribution, development, agricultural, educational and training, and domestic There is every indication that a really important gathering will take place H M Government is to invite members to a reception, and the Lord Mayor and Corporation will receive them in the Guildhall A series of visits to factories and institutions will take place in the week following the Congress Invitations to the Congress containing membership forms and full details may be obtained from the Secretary, 21 Tothill Street, London, S W 1

Catalogue of Microscopes and Accessories

WE have received from Messrs W Watson and Sons, Ltd, the new edition of their catalogue of microscopes and accessories (Parts 1 and 2) The pages devoted to principles of construction on the optical bench system, now applied to all Messrs Watson's microscopes, are of particular interest, and other constructional details in these pages are also noteworthy as evidence of the care devoted to the attainment of rigidity and accuracy Attention may also be directed to the description of the dark ground condenser which can be made with working distances up to 4 mm and to the low power binocular dissecting microscope, strong in build and with two pairs of objectives mounted on a double nosepiece so arranged that the pair not in use is turned into a protected position A considerable range of lamps for various microscopic purposes includes the Greenough lamp, which rests on the table beneath the microscope stage in place of the mirror and gives an evenly illuminated field, provision being made for centring the filament

Announcements

SIR JOHN AMBROSE FLEMING has been awarded the Kelvin Medal for 1935 of the Institution of Civil Engineers in recognition of his services to electrical science and particularly of his invention of the thermionic valve The Kelvin Gold Medal is awarded triennially as a mark of distinction in engineering work or investigation of the kinds with which Lord Kelvin was especially identified

AT the meeting of the Australian National Research Council at Melbourne in January, the first award of the Lyle Medal was made, the recipient being Prof J. R Wilton, Elder professor of mathematics in the University of Adelaide, for his work in mathematics This medal is to be awarded, at intervals of two years, to workers in Australia for such researches in mathematics or physics as may appear to the Council most deserving of such honour, the period covered by those researches being the five years preceding each award

THE services of Prof R. H. Dastur, professor of botany at the Royal Institute of Science, Bombay, have been secured on loan from the Bombay Government by the Government of the Punjab for the investigation of the cotton crop His address for some years, therefore, will be the Cotton Research Laboratory, Lyallpur, Punjab

THE Congress of the German Röntgen Society will be held in Berlin on April 28–30 under the presidency of Prof W. Baensch, from whom further information can be obtained at his address, Liebigstrasse 20a, Leipzig

A **DISCUSSION** on the "Origin and Relationships of the British Flora", to be opened by Prof A C Seward, has been arranged by the Royal Society for the morning and afternoon of March 28. Other speakers will include Mrs E M Reid, Prof P G H Boswell, Miss M E J Chandler, Dr H Godwin, Dr A J Wilmot, Prof E J Salisbury, Dr G Einar du Rietz, Mr H. Davey, Prof O T Jones, Dr R L Praeger, Dr K Sandford, Dr G C Simpson, Mr J B Simpson, Dr W B Wright

AT the annual general meeting of the Microchemical Club held on March 16 at the London School of Hygiene and Tropical Medicine the following officers were elected for 1935–36 *Hon Treasurer and Librarian*, Dr L H N Cooper, Marine Biological Laboratory, Plymouth , *Hon Secretary*, Dr S J Folley, National Institute for Research in Dairying, Shinfield, Reading Vacancies on the committee were filled by the election of Miss I H Hadfield and Dr. J R P O'Brien

THE International Association for the Prevention of Blindness will hold a meeting at the Royal Society of Medicine, 1 Wimpole Street, W 1, on April 5, during the Congress of the Ophthalmological Society of the United Kingdom The agenda are as follows (1) address by Prof de Lapersonne, president of the Association , (2) proposed international classification of the causes of blindness, by Prof van Duyse, of Ghent , (3) hereditary diseases of the eyes ending in blindness and their social consequences, by Prof Franceschetti, of Geneva

A **SYMPOSIUM** on the "Welding of Iron and Steel" will be held at the Institution of Civil Engineers, Great George Street, Westminster, S W 1, on May 2–3, under the auspices of the Iron and Steel Institute, in co-operation with the principal engineering and metallurgical societies of Great Britain The symposium will be divided into four groups, namely (1) present-day practice and problems of welding in the engineering industries , (2) welding practice and technique, including welding apparatus , (3) the metallurgy of welding , (4) specification, inspection, testing and safety aspects of welding Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S W 1

AN animal welfare society has just been formed in the Otani University, Kyoto, Japan, to be affiliated to the University of London Animal Welfare Society Prof Beatrice Susuki, professor of agricultural and forest chemistry, is leader and secretary Communications addressed to the new society will be received and forwarded by the University of London Animal Welfare Society, 68 Torrington Square, London, W C.1

THE Institute of Public Health of the University of Budapest, the sixtieth anniversary of which is to be celebrated this year, is the first institute of the kind to have been founded In 1882, public health became a compulsory subject in the Budapest faculty of medicine and in 1893 in the faculty of pharmacy The first director of the institute, Josef Fodor, who was also the founder of the Hungarian Society of Public Health, was a savant of world-wide reputation, and an excellent organiser, thanks to whose efforts the medical supervision of schools became generalised throughout western and southern Europe

WE have received from the Association of British Chemical Manufacturers, 166 Piccadilly, London, W 1, a copy of "British Chemicals, 1935" (Pp 459, bound in cloth) This is printed in English, French, German, Italian, Portuguese and Spanish, and gives the names of British manufacturers of classified products, a list of proprietary and trade names of materials, with their manufacturers, and indexes in the various languages The volume is published gratis, but is obtainable only on direct application to the Association by genuine purchasers of chemicals

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A temporary engineering assistant for the Directorate of Works in the War Office— The Under Secretary of State (C 5), The War Office, London, S W 1 (March 28) A chemist for rubber research (Malaya and Ceylon)– The Secretary, London Advisory Committee for Rubber Research (Malaya and Ceylon), Imperial Institute, London, S W 7 (March 28) A principal of the East Ham Technical College– The Secretary for Education, Education Office, Town Hall, East Ham, E 6 (March 30) Two junior assistant bacteriologists in the City Bacteriologist's Department, Liverpool--Town Clerk Municipal Offices, Dale Street, Liverpool, 2 (April 2) An assistant agricultural officer to the Kent County Council—The Chief Agricultural Officer, Brunswick House, Buckland Hill, Maidstone (April 4) A principal of the Northern Counties' Training College of Cookery and Domestic Science, Newcastle-upon-Tyne– The Secretary, 4 Royal Arcade, Newcastle upon-Tyne (April 8) An assistant keeper (second class) on the Higher Technical Staff of the Library of the Science Museum - The Director, Science Museum, South Kensington, S W 7 (April 13) A research worker in cancer—The Research Director, North of England Cancer Campaign, 14 Ellison Place, Newcastle-upon-Tyne (April 14) A demonstrator in organic chemistry at Bedford College for Women, Regent's Park, N W 1 —The Secretary (April 27) A chemist for the Main Drainage Department of the Ministry of Public Works, Egypt --The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, London, S.W.1. A principal of University College, Nottingham—Alderman E Huntsman, 1 Bridlesmith Gate, Nottingham

ERRATUM. In the list of members of council of the National Institute of Sciences of India, printed in **NATURE** of March 16 (p 442), for "Dr. Baini Prasad" read "Dr Baini Prashad"

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 475.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radioactivity of some Rarer Elements produced by Neutron Bombardment

EXPERIMENTS on the Fermi effect with some rarer elements have given the results summarised below. The neutrons were obtained from sources of radon, in quantities up to 100 millicuries, sealed in small glass tubes with powdered beryllium, and the radioactivity produced was measured with a Geiger-Muller counter which had been carefully calibrated with weighed amounts of uranium oxide. To utilise the enhanced activity produced by surrounding source and specimen with hydrogen compounds[1] most of the irradiations were carried out in a cavity in the middle of a large block of paraffin wax. The main results obtained are collected in the following table.

Element	Half life	Relative intensity
Silver	2·33 min.*	1
Iodine	25 min.*	0·7
Europium	9·2 hr. ± 0·1	19
Terbium	3·9 hr. ± 0·1	0·5
Erbium	2·9 hr. ± 0·1	3
Ytterbium (? Lutecium)	2·5 hr.	0·6
Germanium	c. 2 hr.	0·1

* Quoted from reference 2.

The relative intensities give a rough comparison of the activities produced per gram atom when irradiated in the wax block in a fixed position for a time long compared with the half life. Measurements on silver (2·33 min. activity) and iodine were also made to serve as standards.

Europium, terbium and gadolinium were kindly supplied as very pure oxides by Dr. J. K. Marsh. Europium shows a remarkably high activity compared with that of silver. Since the 20 sec. period of silver gives an intensity about four times that of the longer period, europium gives about four times the total activity of both periods of silver. The 'water effect' for europium was roughly determined and the activity was found to be increased forty times by irradiating the specimen in the wax block. The β-ray spectrum is now under investigation in the Physics Department of this College; the maximum energy is approximately $2·0 \times 10^6$ e.v. In addition, γ-rays have been detected which are little absorbed by 4 mm. of lead.

A specimen of pure white gadolinium oxide (Gd_2O_3) which had been freed from europium and terbium[3] gave no detectable activity with the sources used. The activity with a half life of 8 hours reported by Fermi and his co-workers[2] may possibly be due to the presence of a small amount of europium, which is not easily separated except by the method of electrolytic reduction. The terbia used in these experiments had been carefully purified for atomic weight determinations[3].

Specimens of erbia and ytterbia originally supplied by Merck were kindly lent by Prof. J. F. Spencer. In addition to the strong activity with a half life of 2·9 hours, erbia gave a much weaker activity with a period of *c.* 30 hours. As, however, the specimen used may contain other rare earths, this period cannot definitely be ascribed to erbium. The ytterbia contained lutecium, so that the activity observed may be due to this element. It is hoped shortly to settle this point by examining specimens of these elements which have been separated by electrolytic reduction.

A specimen of pure scandia from Messrs. Adam Hilger, Ltd., which had been tested spectroscopically and was at least 99 per cent pure, gave no detectable activity when irradiated for 15 hours with 100 millicuries. Another specimen kindly lent by Prof. G. T. Morgan also gave no activity. The activity with a period of 16 hours reported by Hevesy[4] must presumably have been obtained with much stronger sources of neutrons.

I am much indebted to Prof. P. M. S. Blackett for his encouragement and advice whilst this work was in progress.

S. SUGDEN.

Chemistry Department,
Birkbeck College,
London, E.C.4.
March 9.

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[1] Fermi *et al.*, *Ric. Scient.*, V, 2, 7-8; 1934.
[2] Fermi, D'Agostino, Amaldi, Pontecorvo and Segré, *ibid.*, Jan. 1935.
[3] Marsh, *J. Chem. Soc.*, 1972; 1934.
[4] Hevesy, NATURE, **135**, 96, Jan. 19, 1935.

Curare

IN 1931 Hartridge and West[1] noted a rigidity-removing ('lissive') action of curare in experimental parathyroid tetany in dogs. The application of the drug to diseases involving muscular rigidity in man was undertaken by West in a wide series of cases[2]. As it was observed quite early in the investigations that the 'lissive' action was apparently only present in certain samples of curare and might be due to some constituent other than the 'curarines' to which the classical action of curare is due, a broad chemical survey of the much neglected field of the curares was undertaken by the writer in close co-operation on the pharmacological side with Dr. Ranyard West.

Through the valuable co-operation of the Curator of Forests, British Guiana, we have been able to examine a number of *Strychnos* species, kindly identified botanically by the Kew authorities, for pharmacologically active alkaloids. The species examined, their numbers in the Forest Department Records[3], and their approximate relative total alkaloidal contents are shown in the following table.

Species	Rec. No.	Alkaloid Content.
Strychnos Erichsonii	2284	+ + + +
toxifera	2278, 2285	+ + +
,, *Melinoniana*	2260, 2279, 2286; 2303	+ +
,, *diaboli*	2295	+ +
,, *diaboli ?*	2270	+
,, *Mitscherlichii*	2261	0
Guettarda acreana	2317	+ + + +

Of these *Strychnos* species one only, *St. toxifera*, contains an amorphous quaternary alkaloid, to the extent of 0·2 per cent, indistinguishable chemically and pharmacologically from the paralysing principle curarine isolated from calabash or gourd curare from various native sources Curarine from either source is readily isolated after suitable preliminary treatment, by precipitation with mercuric chloride, further purification being effected through the sparingly soluble amorphous iodide This is the first occasion on which curarine has been isolated from *St toxifera* bark of certain identity, and it confirms Robert Schomburgk's discovery of *St toxifera* as the source of the main active ingredient of the curare of the Macusi Indians *Guettarda acreana* is a reputed ingredient of native curare, but although rich in alkaloids, it does not contain a paralysing principle

Through the kindness of the Department of Ceramics of the British Museum and of Mr T E Wallis, curator of the Museum Department of the Pharmaceutical Society, we have been able to examine native preparations of tubocurare, put up in bamboo tubes and quite distinct from calabash curare as was emphasised by Boehm The other soluble crystalline alkaloid *l* curine isolated by Boehm from tubocurare has already been shown by Späth, Leithe and Ladeck to be the optical enantiomorph of *d* bebeerine (α chondodendrine), an alkaloid found in *Radix Pareirae bravae* (Chondodendron spp) by Scholtz The accompanying quaternary alkaloid tubocurarine obtained in an amorphous state by Boehm[4] has now been crystallised for the first time and has a paralysing activity on the frog only slightly less than that of curarine from *St. toxifera* Tubocurarine is dextro-rotatory and has the empirical formula $C_{19}H_{22}O_3NCl$, which if doubled would make the salt isomeric with bebeerine methochloride. The double structure is supported by the results of *o* methylation Although *d*-tubocurarine chloride and *d* bebeerine methochloride are closely similar in general properties, they are not identical; and *d*-bebeerine methochloride has a paralysing activity on the frog considerably less than that of *d* tubocurarine chloride

The nature of the isomerism between *d* tubocurarine methochloride and *d*-bebeerine methochloride is under investigation, their *o*-methyl derivatives are different, but it is suggested that both will be represented eventually as being built up from two norcoclaurine units[5]

HAROLD KING

National Institute for Medical Research,
Hampstead
March 4

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[1] *Brain*, **54**, 312, 1931
[2] *Proc Roy Soc Med*, **25**, 39, 1932 *Lancet*, p 88, 1935
[3] *Kew Bulletin*, **8**, 390, 1933
[4] *Abhandl. Kgl. sächs Ges Wissensch*, **22**, 201, 1895
[5] H King *Ann Rep Chem Soc*, **30**, 242, 1933

Flame Temperatures

WE have expressed the view[1] that flame temperatures determined by the sodium line reversal method are in general far greater than the true flame temperatures (mean molecular translational energy), but considerable criticism has been received which suggests a firmly held opinion that the sodium method measures true flame temperatures—at least approximately The following facts are put forward in support of our view

The sodium method and the platinum resistance method (a 0 0005 in. platinum rhodium wire) yield very nearly (and almost exceptionally) the same temperatures during the combustion of carbon monoxide – air mixtures in the neighbourhood of the 'correct' mixture But as the mixture strength is varied, the two methods yield temperatures which increasingly differ from one another until a 52 per cent mixture is reached, when the difference amounts to as much as 500° C The sodium temperatures as measured by Ellis and Morgan[2] (using a Smithell's separator supplied with perfectly mixed mixtures) remain roughly constant over this wide range of mixture strengths at rather more than 1,900° C (and qualitatively similar results were obtained in the sodium measurements of Loomis and Perrot and Griffiths and Awbery). The platinum wire temperatures, on the other hand, drop through this range of mixture strengths by more than 400° C, and this is much in accord with what would be expected from calculation

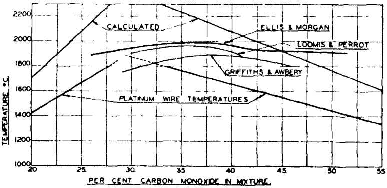

FIG 1 Flame temperatures in carbon monoxide - air mixtures The calculated temperatures are shown uncorrected for dissociation As the actual temperatures in the flame gases are less than 2,000° C, dissociation in them is small and a fairer perspective is obtained by comparing them with calculated temperatures uncorrected for dissociation

These results may be confirmed by an inspection of curves shown in Fig. 1 It will also be seen that for very over-rich carbon monoxide – air mixtures the sodium temperatures of Ellis and Morgan are much in excess even of the ideal temperatures calculated upon the basis of complete combustion and no radiation loss (some 200° C in excess in the case of the 52 per cent mixture) An examination of the large numbers of sodium measurements made by Jones, Lewis and Seaman[3] in various hydrocarbon – air flames shows that they too are frequently much greater than the calculated temperatures—particularly in the case of very over-rich mixtures and sometimes in the case of weak mixtures

In general, then, sodium flame temperatures should not be taken at their face value as indications of true flame temperatures The error in doing so may amount to hundreds of degrees centigrade. Of course the sodium temperatures must have some significance, and a clue to this may possibly be found in the fact that most of the sodium measurements on record in scientific literature, when examined over a wide range, suggest a tendency towards independence both of the nature of the combustible gas and of the mixture strength; in any event they do not vary nearly so much as the calculated temperatures

Our platinum temperatures for all gases so far examined vary with the mixture strengths very much at the same rate as the calculated temperatures, but they are many hundreds of degrees below them[4] It has been suggested that this is because they require a very large correction for radiation loss We have given many reasons for the view that our measurements (which we have always given uncorrected for radiation loss) do not require a correction of more than about 40° C even at the highest temperatures, and indeed if they did they would be much above the sodium temperatures in the neighbourhood of the 'correct' carbon monoxide air mixtures (see Fig 1)

Our measurements were made during the pressure period in gaseous explosions, and we took continuous records for a considerable time after the flame front had passed over the platinum wire but there were no signs of increasing temperature Indeed the temperature remained remarkably steady

It was mainly for these reasons that we felt justified in postulating that flame gases hold a long lived latent energy, which in flames burning at atmospheric pressure seems never to be less than about 15 per cent of the heat of combustion, and in the case of carbon monoxide flames is of the order of 20 per cent

W T DAVID

Engineering Department,
University, Leeds
Feb 23

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[1] David and Jordan, *Phil Mag*, **18**, 228, 1934 David *Engineering* Nov 2, 1934

[2] *Trans Faraday Soc*, **28**, 826 1932

[3] *J Amer Chem Soc*, **53**, 1, 869, 1931

[4] David and Jordan, *Phil Mag* **17**, 172 1934 and **18**, 228 1934, and many series of unpublished results

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Stokes's Formula in Geodesy

IN NATURE of February 20, 1932, a letter appeared from Mr B L Gulatee under the above heading This was responded to by Mr Walter D Lambert in the issue for June 4, 1932

Mr. Gulatee showed me his letter before he sent it off, we discussed it together, and on the whole I agreed with it; but during the past year I have given much attention to the application of Stokes's method to the determination of the earth's figure, and a paper on the subject has just been communicated to the Royal Society.

I am now convinced that, while Mr Gulatee's letter is generally correct in the statements made it gives a wrong impression of the case Mr Gulatee said, "I believe it will never be possible to use it [Stokes's method] for getting absolute elevations" My recent studies have convinced me that it will be possible to do so.

Mr Gulatee gave some figures showing a particular case as example in which an error of 0 01 gal in '*g*' would lead to an error of 40 ft in geoidal elevation, and he added that "A systematic error of 0 01 in zones from 40°-100° and of − 0·01 in zones from 130°-170° would vitiate the results hopelessly", which is very true Systematic errors are very much to be guarded against and it is essential that all possible precautions be taken to avoid them. However, a systematic error of 0·01 over the whole globe would lead to zero error of geoidal elevation; and it is artificial to suppose that systematic error should prevail over one half (nearly) of the globe and then reverse its sign for the other half, as suggested in the quoted passage. When a considerable region of the earth, such as 100,000 square miles, is to be represented by a single gravity determination, it is no doubt true that the observed anomaly will deviate from the mean value for the area, but *not* systematically The deviation, which may be called the 'representative error', is mainly of the nature of an accidental error, due to irregularities in the earth's crustal density, and so the combined effect of such errors in each of some 2,000 elementary areas of quadrature should be very different from what was suggested by Mr Gulatee

In my paper, alluded to above, I have gone carefully into this matter I find that, with 1,700 stations evenly spaced over the earth's surface, combined with 100 stations suitably distributed locally, the probable error of geoidal elevation at a point will be ± 34 ft, while the probable error of tilt, found from a derived formula, will be ± 0 35 in

It is to be noted that 34 ft is only 1 6 × 10^{-6} of the earth's mean radius, and such precision is of the same order as though smaller than, the lowest estimates of probable error of the earth's mean radius For fixing the elevation of the origin of a large survey, which is a practical requirement, the accuracy is ample in relation to the standard of accuracy of the survey, and there is every justification for making the necessary gravity determinations to enable the calculations of geoidal rise and tilt to be carried out

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Three-fold Magneto-ionic Splitting of the Radio Echoes reflected from the Ionosphere

THE phenomenon of reflection of radio waves from the ionosphere and the observed echo patterns has received satisfactory explanation from the magneto-ionic theory, first put forward by Appleton[1]

It is well known that a dispersion formula can be easily obtained from the generalisation of Lorentz's treatment of the problem of the propagation of the electromagnetic wave in a magnetic field For vertical propagation, when damping is negligible, it has been shown that

$$\mu^2 = 1 + \frac{2}{2\alpha - \frac{\gamma_T^2}{1+\alpha} \pm \sqrt{\frac{\gamma_T^4}{(1+\alpha)^2} + 4\gamma_L^2}} \quad . (1)$$

where

$$\alpha = -\frac{n^2 m}{N e^2}, \quad \gamma_T = \frac{n h_z}{eNc} \text{ and } \gamma_L = \frac{n h_x}{eNc}$$

Reflection occurs when μ is equal to zero. From formula (1) we can plot a dispersion curve for various values of N, the number of electrons in a unit volume It can then be shown that we get μ equal to zero for three different values of N (N_1, N_2, N_3) obtained from the conditions given below

$$\left.\begin{array}{ll} 1+\alpha = -(\gamma_T^2+\gamma_L^2)^{\frac{1}{2}} \quad . & (a) \\ 1+\alpha = 0 \quad . \quad \quad . \; . & (b) \\ 1+\alpha = +(\gamma_T^2+\gamma_L^2) & (c) \end{array}\right\} \quad . \quad (2)$$

From these conditions it appears that there will be three different heights corresponding to the above three values of N from which we can get reflections. But usually only a doublet is observed corresponding to conditions (*a*) and (*b*) of formula (2) Corresponding to (*a*) we get an extraordinary ray (shorter delay component) and corresponding to (*b*) we get an ordinary ray (the longer delay component) Reflections corresponding to (*c*) or N_3 (which is the highest concentration of electrons for which μ is again zero) are not usually observed, since the amplitude of the disturbance when it reaches the greatest height is very small, or even if it is reflected with sufficient amplitude from these heights the amplitude falls during its passage through the lower layer (See Mary Taylor[2] who considers this possibility)

As already reported in NATURE[3], a systematic investigation of the heights of the ionosphere is being carried out in this laboratory, and on several occasions different observers[4, 5] have independently noticed the appearance of a very close triplet set of the first reflected echo, two of these can be easily identified with those corresponding to N_1 (2,*a*) and N_2 (2,*b*), but the third can only be identified with N_3 (condition 2,*c*) The most favourable time for the occurrence of the triplet seems to be after sunset, when the first echo from the *F*-layer just begins to resolve into the ordinary and extraordinary ray The triplets occur rather irregularly and have not been found to exist for more than a minute On most favourable occasions when the measurement could be taken from visual observations, the separation of the components corresponded to an equivalent height of about 15 km

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Feb 7

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[1] E V Appleton, U R S I papers (Washington, 1927) Appleton and Builder, *Proc Phys Soc Lond*, **45**, 208, 1933

[2] *Proc Phys Soc Lond*, **45**, 261, 1933

[3] G R Toshniwal and B D Pant, NATURE, **133**, 947, 1934

[4] G R Toshniwal and B D Pant, see appendix of a paper read before the first meeting of the National Institute of Sciences on Jan 8, 1935 (in the press)

[5] R R Bajpai, Thesis for M Sc Examination T D Bausal, Thesis for M Sc Examination

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Absorption of Cosmic Rays

THE Klein-Nishina formula, which is based on the scattering and absorption of X- and γ-radiation by extra-nuclear electrons, has been widely used in the calculation of the absorption coefficients of high-frequency quanta. But recent experimental work and theoretical deductions have shown that this formula is not applicable to the absorption of γ radiation of energy greater than $1 0 \times 10^6$ e v, since for higher energies there is additional absorption due, in the main, to interactions between the radiation and atomic nuclei, these interactions giving rise to electron pairs This nuclear absorption, which becomes of greater importance as the energy of the quanta increases, and is probably the predominant type of absorption which would occur with any ultra γ-radiation arising from actions such as the condensation or annihilation of protons and electrons in space, is not accounted for by the Klein-Nishina formula The latter cannot, therefore, be directly applied to the cosmic ray problem as has been previously assumed, and the wave-lengths of supposed photon components calculated by means of this formula must be inaccurate, since the formula does not take into account the nuclear absorption.

Even assuming that the primary rays are photons, the agreement which has been obtained between the absorption coefficients calculated by assuming some hypothesis as to the process giving rise to the quanta, and the experimentally observed coefficients, is fortuitous, since nuclear absorption is neglected by the Klein-Nishina formula Thus, before any postulation as to the origin of the rays which utilises agreement between calculated and observed absorption coefficients of ultra γ radiation can be accepted, a theory of absorption which takes account of nuclear interactions must be developed

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Feb 12

Random Distribution of Parasite Progeny

RECENT work by Salt[1] led him to question the validity of the hypothesis of the random distribution of progeny by parasites In this connexion, experiments at Farnham House Laboratory with *Schedius kuvanæ*, a chalcid egg-parasite of the gipsy moth (*Porthetria dispar*), will be of interest Although no figures are given here, those obtained in the experiments were such as to leave no doubt as to their significance

Subject to controlled environmental conditions, and given a sample of host eggs all equally exposed to attack, the female almost invariably parasitises each available host with a single egg. If no healthy (unparasitised) hosts are present, the rate of laying (per diem) is approximately halved, that is, she tends to retain her eggs rather than deposit them in parasitised hosts There is considerable individual variation in this ability to refrain from ovipositing in parasitised hosts—a feature which was also indicated in the table of Salt's work on *Trichogramma evanescens*

The discriminating faculty is not due to memory, and seems to be of a qualitative rather than a quantitative nature. When a series of *Porthetria* eggs, containing respectively 0, 1, 2, 3 and 4 eggs deposited by a given female, are exposed to another female for a given time, at least 80 per cent of the progeny are placed in the hosts that contained no eggs when first offered to the female, these often being superparasitised with three or four eggs This peculiarity of laying the great majority of additional eggs in hosts which a given female had herself parasitised in the original instance, in preference to hosts parasitised by other females, has been noticed in numerous cases where superparasitism was enforced by the experimenter.

The selective faculty is of a surprisingly high order, enabling the insect to choose the best of available host material. Thus, given a choice between—

(1) dead and alive gipsy moth eggs, she selects chiefly live eggs ;

(2) dead healthy eggs and dead eggs, each containing a single dead parasite, she selects the healthy host ;

(3) dead healthy eggs and dead eggs, each containing a single live parasite, again the healthy eggs ,

(4) dead eggs each containing a single dead parasite and dead eggs containing a live parasite, she usually deposits in the former.

It should be stated that the female *Schedius* deposits her egg in the host with a portion of the pedicel protruding through the gipsy-moth egg shell, this probably performing a respiratory function. To eliminate this as a means of distinction between parasitised and unparasitised eggs, all pedicels were removed with a sharp scalpel before the experiments. These preliminary experiments suggest that the oviposition response in *Schedius* cannot be due to any simple stimulus. It is hoped to investigate the conditions under which this selective faculty is impaired or destroyed.

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Feb. 7.

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[1] Salt, G., *Proc. Roy. Soc.*, B, **114**, 455; 1934.

Diet of Seals

THE recent illegal slaughter of grey seals in the supposed interests of the Cornish fishermen directs attention to the diet of seals. On what do they usually feed? On fish, as the fishermen and their friends assert, or on some of the other creatures which abound in the waters of the ocean?

Obviously the diet of seals, like that of whales, can be ascertained only by opening their stomachs and examining their contents. In the case of the arctic and antarctic seals this has been done to a considerable extent.

Nansen[1], R. Brown[2], Kumlein[3], Malmgren[4] and Chapman Spencer[5] all testify to the extent to which the arctic seals feed on creatures other than fish—squid, crustaceans and shellfish—and, in the case of the antarctic seals, the evidence of E. A. Wilson[6] and Matthews[7] is equally strong.

As to the diet of the grey seal, there seems to be very little scientific evidence beyond that which is contained in Mr. Steven's report[8]. Unfortunately, Mr. Steven was only able to examine the stomach contents of three seals; there were fish remains in two, and a cuttle-fish beak in a third. The examination by him of a greater number of stomachs might have led to the discovery of more remains other than those of fish, that is, those of crustaceans and shellfish, and might have still further weakened the case against the grey seal.

Until the matter is more fully investigated, the destruction of grey seals on the plea that they destroy large quantities of food-fish does not seem to be justified.

R. W. GRAY

Exmouth.
Feb. 19.

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[1] Nansen, "Hunting and Adventure in the Arctic", p. 207.

[2] Brown, R., "On the Seals of Greenland", *Proc. Zool. Soc., Lond.*, p. 411, 1868.

[3] Kumlein, L., "Report of the Howgate Polar Expedition".

[4] Malmgren, *Arch. Naturg.*, p. 75, 1864.

[5] Chapman Spencer, "Watkins's last Expedition", pp. 116, 134, 223 and 280.

[6] Wilson, E. A., "National Antarctic Expedition", 11, 13, 28, 36, 44 and 45.

[7] Matthews' "Discovery" Report on the Natural History of the Elephant Seal.

[8] Steven, G. A., "A Short Investigation into the Habits, Abundance, and Species of Seals of the North Cornwall Coast", *J. Mar. Biol. Assoc.*, **19**, No. 2, 489–502, May 1934.

Red 'Water-Bloom' in British Columbia Waters

IN NATURE of September 22, 1934, there is a communication from Mr. T. John Hart describing the occurrence of a red 'water-bloom' caused by *Mesodinium* in South African seas. It may be of interest to record an occurrence of blood-red water at Nanaimo, British Columbia, during the week of April 28, 1933. The water in a channel immediately north of the harbour was coloured crimson red in great patches. Examination of a sample of the water revealed a pure culture of a ciliate, identified by Mr. G. H. Wailes as *Mesodinium rubrum*, Lohmann.

About this time oysters in Ladysmith Harbour, fifteen miles south of Nanaimo, were reported to contain red 'worms'. Investigation disclosed the fact that the crystalline styles were coated with a red colouring matter, evidently as a result of feeding upon *Mesodinium*. Examination of the styles of local clams showed a similar condition.

The appearance of this 'bloom' of *Mesodinium* followed a period of a couple of weeks of bright, sunny, calm weather. No discoloration was observed in 1934.

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Magnetic Measurement of Ionic Deformations in Crystals

DURING the past few years, it has been shown that the diamagnetic susceptibilities of ions in crystals are approximately additive, and their values are in fairly close agreement with values calculated theoretically from the wave mechanical structures of free ions[1]. Attempts to interpret the experimental results in more detail have been handicapped by a lack of essential data, for although results are now available for many substances, some have been obtained for solutions and others for crystals, and the two are not directly comparable. With the view of obtaining more precise information for a particular group of crystals, we have studied the susceptibilities of the alkaline halides, using a method of measurement previously described[2].

We have been specially interested to see how closely the additivity principle holds in this group of crystals, and we find that in general it holds to within 1 per cent. The results for the rubidium halides are typical.

Salt	Diamagnetic Susceptibilities $X \times 10^6$		
	(1) Obs.	(2) Calc.	ΔX, (1)–(2)
RbF	31·9	31·4	–0·5
RbCl	46·4	46·2	–0·2
RbBr	56·4	56·5	0·1
RbI	72·2	72·6	0·4

The only important exceptions to the additivity rule are the chlorides, bromides and iodides of lithium and cæsium, for which the calculated values exceed the observed values by 1·6, 1·5 and 1·3 in the case of the lithium salts, and by 2·7, 2·4 and 3·1 in the case of the cæsium salts. For the other halides upon which measurements have been made in the course of this work, the differences are of the order of 0·2–0·3.

Exceptional results might have been expected for the cæsium halides, since these crystals have a different structure from the other halides, all of which have the rock-salt type of structure. A different explanation is suggested in interpreting the results for the lithium halides. These crystals are composed of the small Li^+ ion and the relatively large Cl^-, Br^- and I^- ions; the negative ions here approach more closely than in the other halides, and the greater electrostatic repulsions produce larger interatomic distances than would be expected from considerations of the 'sizes' which these ions have in the other halides[3] The conclusion we draw is that the interatomic forces which thrust apart the negative ions in the lithium halides and result in a change of structure in the case of the cæsium halides produce deformations of the ions which *lower* their susceptibilities We find that this conclusion holds good also for the ammonium halides, the chloride and bromide of which normally have the CsCl type of structure and show low values for their susceptibilities, while the iodide has the NaCl type of structure and gives a normal susceptibility.

A detailed account of this work will appear elsewhere.

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Jan 25

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[1] See E C Stoner, "Magnetism and Matter", chap ix (Methuen, 1934)

[2] F E Hoare, *Proc Roy Soc*, A, **147**, 88, 1934

[3] See L Pauling, *Z Krist*, **67**, 377, 1928 W Zachariasen, *Z Krist*, **80**, 137, 1931

Variation of the Carbon-Halogen Link Distances in Different Types of Organic Structure

THE improved electron diffraction method[1] of determining molecular structure in the vapour phase has brought to light the fact that the distance between a carbon and halogen atom depends on the character of the binding attaching the carbon atom to other atoms in the system Hitherto, the magnitude of this distance has been regarded as constant We have shown that the carbon-halogen distance is smaller in aromatic compounds than are the accepted values for the aliphatic series[2]. This suggested that an investigation of certain aliphatic, ethylenic and acetylenic compounds by electron diffraction might throw more light on this question.

	Aliphatic $>C-Hal$		Ethylenic $=C<^{Hal}_{Hal.}$		Aromatic $C-Hal$	Acetylenic $\equiv C-Hal$
Link	New	Old	New	Old	New	
C–Cl C–Br C–I	1 76[7] 1 93 2 12	1 82[4,5] 2 05[4,6] 2 28[6]	1 74 1 91 2 10	1 82[7,4] 2·05[4] —	1 69 1 88 2 05	— 1 84 2·03
	CCl_4 CBr_4 CHI_3		*Trans* $C_2H_2Cl_2$,, $C_2H_2Br_2$,, $C_2H_2I_2$ C_2Cl_4 C_2Br_4 C_2I_4		C_6Cl_6 C_6Br_6 Sym $C_6H_3Br_3$,, $C_6H_3I_3$ *p*- $C_6H_4Br_2$ *p*- $C_6H_4I_2$	Dibrom-acetylene Diiodo-acetylene

The 'new' results are tabulated above, showing that the carbon-halogen link distances in angstroms decrease from left to right and are not constant, as the 'old' results would seem to indicate. The order of accuracy is ± 0 01 A Below each column we give a list of the substances used for this work, the results of which will be published shortly in greater detail

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Feb 5

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[1] de Laszlo, *Proc. Roy Soc*, A, **146**, 662, 1934

[2] de Laszlo, *ibid*, **143**, 690, 1934

[3] Cosslett and de Laszlo, NATURE, **134**, 63, 1934

[4] Wierl, *Ann Phys*, **8**, 521, 1931

[5] Dornte, *J Chem Phys*, **7**, 567, 1933

[6] Dornte, *ibid*, **1**, 630, 1933

[7] Wierl, *Ann Phys*, **13**, 553, 1932

Dipole Moment of Acetonitrile

ALTHOUGH several determinations of the dipole moment of acetonitrile have been made, considerable uncertainty attached to the results since the values of different observers varied widely. The figures already published for this compound are as follows

	μ	Temp
Williams, *Z physikal Chem*, **138**, 75, 1928	3 4 D	25° C.
Werner, *ibid*, B, **4**, 371, 1929	3 11	20°
Eide and Hassel, *Tids Kjemi*, **10**, 93, 1930	3 51	—
Hunter and Partington, *J C S*, 2812, 1932	3 16	20°
Snoek, *Physikal. Z*, **35**, 196, 1934	3 45	25°

In all cases the solvent was benzene.

We recently remeasured the moment of acetonitrile in connexion with some other work, shortly to be published, and have found a value $\mu = 3 \cdot 44 \pm 0 \cdot 02$ D at 20°. This figure is in excellent agreement with that obtained by Snoek

The two lowest values quoted above were both found using acetonitrile which had been repeatedly fractionated with phosphorus pentoxide. This treatment would not remove traces of acetic acid formed by slight hydrolysis of the cyanide, and possibly the low values are in part due to this cause. It may be noted that the moment of acetic acid in solution is about 0·8 D (Wolf; *Physikal. Z.*, **31**, 227; 1930) although smaller values have been recorded

In the present experiments, Kahlbaum's acetonitrile was purified by standing over caustic potash to remove any traces of acid, was then left in contact with calcium chloride for a week to remove any ammonia, and was finally dried with phosphorus pentoxide. It was twice fractionated over phosphorus pentoxide, and had a constant boiling point 81·6°C /760 mm ; d^{20}_4 0·7823; n^{20}_D 1·3438. Kahlbaum's benzene was used as solvent.

The dielectric constants have been measured on an improved form of the apparatus previously used by us, which we shall describe elsewhere.

The polarisations of acetonitrile are: $P_{2\infty} = 262 \pm 1 \cdot 5$ c c.; $P_E = 11 \cdot 1$ c.c.; $\mu = 3 \cdot 44 \pm 0 \cdot 02$ D.

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Feb 11.

Solid Carbon Dioxide

THE commercial and workshop value of solid carbon dioxide is fully described in a recent article in NATURE[1], there are, however, further interesting uses of this material to which it may be worth while to direct attention

(1) Diamonds and pearls may at once be distinguished from their counterfeits, inasmuch as the real substances emit a rattle or squeak when touched with solid carbon dioxide Similarly, a quartz lens may at once be distinguished from a glass one

(2) Metal bars and tuning forks of high pitch may be powerfully excited by touching them with the substance, and the overtones of low-pitched forks and bars may similarly be picked out—a fact of practical importance in the tuning of metal bars of musical instruments

(3) Brittle materials, of suitably high thermal conductivity, may also be set into vibration

These facts, and the manner of their discovery, were demonstrated before Section A at the York meeting of the British Association As no trustworthy account exists on the origin of these experimental researches, I should like to put on record the actual facts. The well-known fact that solid carbon dioxide will make a bicycle bell rattle was brought to my notice on July 11, 1932, by an itinerant vendor of ice-creams, and investigations were at once entered into, the results of which, together with an explanation of the phenomenon, have recently been published[2,3] Briefly, the loss of heat from the hotter to the colder body supplies the energy, and the efficacy of carbon dioxide is due to the fact that it sublimes, thereby producing considerable gas pressure.

I have recently noticed that solid carbon dioxide in the form of 'Drikold' can set soft metals into vibration in a manner impossible with a hammer

The accidental nature of the discovery and the mechanism of the phenomenon may well be compared and contrasted with that of Trevelyan's rocking bar

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Feb 26

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[1] NATURE, 135, 293, Feb 23, 1935

[2] *Proc Phys Soc*, 45, 101, 1933

[3] *Proc Phys Soc*, 45, 110, 1934

Points from Foregoing Letters

PROF S SUGDEN has investigated the radioactivity induced by neutron bombardment (Fermi effect) in the rarer elements europium, erbium, terbium, ytterbium, etc) He tabulates the relative intensity and half-life periods of the radioactive elements produced, comparing them with the intensity produced in silver and iodine in the same circumstances.

Curare and tubocurare—plant extracts employed by South American Indians as arrow poisons because of their paralysing properties—have been used medically to alleviate muscular rigidity in man Dr Harold King has investigated several species of *Strychnos* and other plants from which curare is said to be obtained Of these, *S toxifera* alone contains the active principle curarine, having paralysing properties Chemical examination of bamboo-tube curare (tubocurare)[1] yielded crystalline tubocurarine, which has properties similar to those of curarine, together with an allied substance *d* bebeerine, which is much less active

The temperature of flames as measured by the increased resistance of a platinum wire does not agree with that determined by the 'sodium line reversal' method (The spectral lines of sodium present in the flame seen against a background of a continuous spectrum of a tungsten filament, of known temperature, appear dark when the flame is cooler and bright when it is hotter than the filament) Prof W. T. David maintains that the 'sodium temperatures' are too high, as they do not agree with the calculated temperatures for flames of carbon monoxide while the 'platinum temperatures' do The sodium temperatures show an unexpected constancy over a wide range of variations in the mixture strength and in the nature of the combustible material.

Stokes's formula shows how, from a knowledge of the variations in gravity at different known points of the earth's surface, one may calculate the shape of the earth's figure (geoid) Mr B L Gulatee suggested that minute systematic errors in the determination of g might completely vitiate the results Dr J de Graaff Hunter now calculates that if gravity determination were made at a large number of stations suitably distributed over the earth, Stokes's formula would give the 'absolute elevation' with a fair degree of accuracy.

According to theory, there should be three different heights in a given ionic layer (of the upper atmosphere) from which radio waves can be reflected, these correspond to certain values in electronic density. Only doublet echo patterns are, however, usually found Mr G R Toshniwal states that triplet radio echoes have been observed at Allahabad from the *F* layer—especially after sunset; the separation of the components indicates an equivalent height difference of about 15 km

Mr H J Walke points out that the Klein-Nishina formula by means of which the wave-lengths of γ-rays are calculated when their absorption coefficient is known neglects nuclear absorption It should not therefore be applied in the case of γ-rays of more than one million electron volts energy, such as those supposed to exist in cosmic rays, since such hard γ-rays can interact with atomic nuclei.

Mr D C Lloyd reports that experiments with the parasite wasp (*Schedius Kuvanae*) which deposits its eggs within those of the gypsy moth, show that the female *Schedius* possesses a selective faculty enabling it to pick the best available material as host.

Mr G W Brindley and Dr F. E Hoare have investigated the diamagnetic susceptibilities of the alkaline halides in order to test how nearly additive are the ionic susceptibilities in this group of crystals. They find that the additive rule holds to within about one per cent in all cases except CsCl, CsBr and CsI (which have different structures from the other halides), and LiCl, LiBr and LiI (where the negative ions are in unusually close proximity)

Research Items

Blood Groups and Physiognomy. Prof. R. Ruggles Gates has recently received from Dr. L. D. Livingston the photographs of six out of eleven Eskimo of Pond Inlet (lat. nearly 73° N.) tested by him for blood-groups, who were regarded as "practically full-blooded Eskimo". The photographs are published in the March issue of *Man*. On inspection by several anthropologists and laymen, two out of the six were selected as pure-blooded, while of the remainder one was singled out by one observer who had experience of Canadian Indians as having Indian blood. The remaining three were regarded by all observers as having European blood. This classification agrees with the blood groups. The two individuals selected as pure Eskimo belong to the *O* group, the remainder to the *A* group. In the instance of the individual showing Indian admixture, this must be explained as due to a remote white strain, which does not show in the features. Otherwise the evidence of physiognomy agrees entirely with the evidence of the blood groups, as usually accepted for American aborigines. The striking fact which emerges is that while the pure-blooded are *O*, those of mixed ancestry are all *A*. It is pointed out that a European who has the *A* group is more likely to be heterozygous than homozygous for *A*. Any white man who is heterozygous for *A* would have an equal chance of transmitting to his offspring in a cross with an Eskimo the genes for European features combined with either blood group *A* or *O*. One must conclude, therefore, that while crosses between a white father who was heterozygous for *A* and an Eskimo woman would in many cases be expected to produce a child of *O* blood-group combined with some European features, yet on the other hand the presence of *A* in the offspring can be taken as confirming the evidence from physiognomy that a cross has taken place.

Mortality amongst Game Birds. The Hungarian partridge (*Perdix p. perdix*) has been introduced into the Great Lakes region of the United States, and there it is better adapted to intensively farmed areas than the native game birds or the pheasant, with neither of which does it seem to compete. Large numbers, amounting to more than 260,000 individuals, have been set free in the United States and Canada, mostly during the present century. In the course of a careful description of the standing and relationships of the Hungarian partridge in the Great Lakes region, Ralph E. Yeatter discusses the mortality at different stages. In the breeding seasons of 1930, 1931 and 1932, out of a total number of 143 nests observed, 32 per cent were successful, 68 per cent unsuccessful. The causes of failure were mainly farming operations, which accounted for 46 per cent of the destruction, predators (26 per cent), desertion (16 per cent), while smaller losses were due to farm animals and hatching failures (Bull. 5, Univ. Michigan, School of Forestry and Conservation, Dec. 1934). In later life, careful counts of birds in definite localities were made during the year, and these again showed a very marked decrease in numbers, both during the winter period, when in one case there was an 11 per cent loss in the course of a month, and during late summer in young birds in their first few weeks. Losses of adults appear to be gradual through autumn, winter and spring.

Aeroplane Dusting and Bees. According to Science Service (Washington, D.C.), bees are often destroyed by poisonous dusts spread by aeroplanes as a means for combating insect pests. The matter came up for discussion before the American Association of Economic Entomologists at a meeting held in Pittsburgh on December 27. One speaker maintained that such aeroplane dusting is responsible for the reduction of about one million colonies of the honey-bee in the United States during the past three decades. The mischief, it is stated, is mainly caused by the drift of poisonous dust into the flowers where they are working. Pollen-gathering bees themselves are unaffected owing to the fact that the pollen is stored on their legs and bodies, but the poisonous food is transferred to the hive, where it is fatal to the larvæ, thus inhibiting the increase of the colony at its source.

Historical Investigation of Heterœcism. A study of the heterœcious fungus *Puccinia graminis* is now part of even an elementary course of biology, and it is difficult to conceive that there was a time when the link between its two hosts, barberry and wheat, had not been established. Mr. J. Ramsbottom has published an interesting article (*Trans. Brit. Mycol. Soc.*, 19, Part 2, 128–138, January, 1935), which reveals the extensive observations made by L. G. Windt, on the connexion between the two hosts. Windt was a "counsellour in the chamber of accounts of the Count De Lippe Schaumberg", and published his findings in a book "Der Berberitzenstrauch, ein Feind des Wintergetreides" ("The Barberry-bush an Enemy to Winter Corn"), 1806. The incidence of disease on wheat and rye when barberry bushes grow in the neighbourhood was established in different places and on numerous occasions. Then wholesale eradication of the bushes was recommended, and sponsored by the Count. This measure was entirely successful, and the book closed with a summary of the available knowledge about the causal fungus. A passage, obviously written just before publication, acknowledges Sir Joseph Banks's demonstration that the æcidium fungus on barberry and the *Puccinia* on wheat were really stages of the same fungus.

Cretaceous Mollusca of Japan. The Cretaceous Lamellibranchs and Gasteropods of the Miyako district of Honshû, Japan, have recently been described by T. Nagao (*J. Fac. Sci., Hokkaido Imp. Univ.*, 4, (2), 177–277; 1934). The Cretaceous deposits occur in six small areas along the eastern border of the Kitakama mountainland in north-eastern Japan, where they rest unconformably on Palæozoic or igneous rocks and consist mainly of sandstones with some layers of shale and conglomerate. They include a rich molluscan fauna, comprising 41 species of lamellibranchs and 28 species of gasteropods, of which the striking feature is the large proportion of forms either identical with or closely allied to those found in Europe. These indicate that the deposits are of Gault age and perhaps in part Aptian, but until the Ammonites have been studied more carefully, exact zonal divisions cannot be made. In addition to the Mollusca, calcareous Algæ, Foraminifera, corals and echinoids are also found. The faunal assemblage in some of the deposits includes numerous examples of a Rudistid lamellibranch (*Præcaprotina*), abundant reef-building corals and *Orbitolina*, recalling the Urgonian facies of Europe

New Type of Filament Hygrometer. In the course of a paper read at the Royal Society of Arts on January 23, entitled "Humidity, Health, and some New Inventions", Mr C L Burdick described a new form of filament hygrometer (*J Roy Soc Arts*, Feb 22, 1935) As is well known, old pine cones continue to open and close with changes of humidity This is due to the fact that the outer layer of the conifer scale or bract consists of highly hygroscopic fibres, which lengthen when moisture is absorbed and shorten with desiccation, and with suitable cone fibres treated so as to oxidise remaining traces of resin, a high degree of reaction to moisture can be obtained Using these treated cone fibres, Mr Burdick has constructed several types of hygrometer With hair, linen or cotton thread, paper or vellum, and gold beater's skin, all of which have been utilised for the construction of filament hygrometers, the zero point undergoes considerable alteration in course of time, but cone fibres have been found to remain almost constant during a period of two years, and the cone fibre in its reaction to moisture has three times the linear contraction and expansion of hair, and is practically non-elastic

Nature of Lightning Discharges In a recent paper on this subject (*J Franklin Inst*, December 1934), Dr Harald Norinder describes the application of the cathode ray oscillograph to the recording of the electric field changes caused by lightning flashes For this purpose the author has used the oscillograph and technique which he developed a few years ago for the study of lightning and other surges on electric power transmission lines A horizontal antenna, suitably damped, was connected to earth through a high resistance, across which the deflecting plates of the oscillograph were connected. The time scale used with the oscillograph gave a sweep time which could be varied from 10 to 10^4 microseconds The paper referred to above gives an account of the results obtained from some 290 oscillograms of lightning discharges, many of which are illustrated It is shown that a lightning flash consists of a series of partial discharges, the duration of which may range up to 200 micro-seconds. When these partial discharges are examined on the high-speed records, they are seen to be of a quasi-oscillatory nature having a period of the order of 60 micro-seconds, with superimposed variations of a duration of 1 or 2 micro-seconds. An analysis has also been made of the polarity of the discharges, and the resulting net field changes At a distance of 2–7 km from the lightning flash, the variation of electric field intensity was found to be of the order of several hundred volts per metre.

Induced Radioactivity. Mr Wenli Yeh, writing from the Institut de Biologie Physico-Chimique, 1 rue Pierre Curie, Paris, sends us details of a classification of isotopes which shows that there is a continuous sequence of radioactive isotopes from $_3Li^8$ to $_8O^{19}$, whereas from $_9F^{18}$ to $_{17}Cl^{37}$ the unstable and stable isotopes alternate, this sudden variation in the sequence affording some evidence of a change in the nuclear structure beyond oxygen. The classification cannot be extended beyond chlorine owing to the lack of experimental data A shell model of the nucleus proposed by Mr Yeh (*Comptes rendus*, **199**, 1209, 1404, 1934) suggests that $_{19}K^{40}$ is formed from $_{19}K^{39}$ by neutron capture, the unstable $_{19}K^{40}$ disintegrating with the emission of positrons, or electrons, into $_{18}Ar^{40}$, or $_{20}Ca^{40}$ Recent work by Klemperer (*Proc Roy Soc*, A, **148**, 638, 1935) indicates that probably the relatively rare isotope K^{40} is responsible for the β-ray activity of potassium A communication upon the same subject has been received from Mr S Nishida, who writes from Konan-Koto-Gakko, Motoyamamura, near Kobe, Japan Applying the Landé neutron shell nuclear structure to the light elements, Mr Nishida finds that the radioactive isotopes which emit negative electrons possess neutrons in excess of those required to complete an inner shell, whereas positive electrons are emitted from those isotopes which have incompleted shells Accordingly there are two types of electron emission, namely, (*a*) a reaction in which an α-particle is formed with γ-ray emission, for example, $_{11}Na^{24} \rightarrow {}_{12}Mg^{24}$, (*b*) the formation of a proton and a deutron, for example, $_{12}Mg^{27} \rightarrow {}_{13}Al^{27}$ In addition, two types of positive electron are possible, in each reaction a proton loses a positron and so an additional neutron is produced, for example, $_7N^{13} \rightarrow {}_6C^{13}$, $_{15}P^{30} \rightarrow {}_{14}Si^{30}$ The proton within the nucleus, if associated with zero or one neutron, is unstable, being converted into a neutron with the emission of a positive electron This suggests that a proton may be formed by the combination of a neutron and a positron

Combustion of Carbon Monoxide. The catalytic action of moisture in the reaction $2CO + O_2 = 2CO_2$ has been clearly realised since the researches of H B Dixon, and different explanations of it have been given W F Jackson (*J Amer Chem Soc*, **57**, 82, 1935) has made experiments with the object of gaining knowledge of the steps postulated in the chain mechanism involving hydroxyl radicals and hydrogen atoms according to the scheme

$$(1)\ OH + CO = CO_2 + H\ ;\ (2)\ H + O_2 + CO = CO_2 + OH.$$

An electrical discharge through moist hydrogen or water vapour provides a reliable source of hydrogen atoms, and there is some evidence that hydroxyl can be drawn from the water discharge It was found that carbon monoxide was oxidised by the products of an electrical discharge through water vapour Numerous substances are present during such a discharge, and the discussion of the probable effects of these shows that several of them could not well be assumed to act as catalysts in the oxidation of carbon monoxide. Atomic hydrogen is shown to cause oxidation but it is considered probable that the reaction does not occur directly according to equation (2) but in two steps, with the intermediate formation of HCO or HO_2 It was found that the products of the action of the discharge on water vapour at pressures below 1 mm. cause the oxidation of carbon monoxide even when they have been drawn several decimetres from the discharge One of the products of such a discharge is shown to be hydrogen peroxide It is considered possible that OH radicals may be withdrawn in sufficient concentration to account for the fraction of the carbon dioxide yield which cannot be attributed to hydrogen atoms.

Archæological Excavations in Iraq[*]

IN the season 1932–33, which is covered by the third preliminary report of the director, Dr. Henri Frankfort, the Oriental Institute of Chicago was responsible for three major investigations in Iraq—at Tell Asmar, Khafaje and Khorsabad, and to the last of these were subjoined two minor investigations at Tepe Shenshi and Jerwan, to which the attention of the field staff was turned when, towards the close of the season, the weather precluded further activity in southern Iraq

The results of the season 1932–33 fully confirmed the impression which had been formed in the previous season that the site at Tell Asmar, the ancient Eshnunna, is likely to prove one of the most important in the south. Not indeed that it is probable that it will eclipse Ur in the richness of the finds or in the imposing character of the buildings; but, on the other hand, the evidence which it has already afforded indicates that it will be of first rate significance in the elucidation of a number of problems of Mesopotamian prehistory

Of these problems one of the most vigorously debated has been the dating of the Royal Tombs at Ur. According to the interpretation of the evidence from Tell Asmar by Dr Henri Frankfort, this must now be placed much lower than has been proposed by Dr L. Woolley, though it does not demand the extreme reduction favoured by some authorities At the time of writing this third report, Dr. Frankfort was not yet in a position to formulate a final judgment, but he was able to show that the evidence pointed to a contemporaneity of the tombs at Ur with the fifth stratum of his series at Tell Asmar, that is, the stratum preceding the Sargonid period. A possible date would, therefore, be c. 2700 B.C as against the c 3500 B.C. which commended itself to Dr Woolley.

The conditions of excavation at Tell Asmar were peculiarly favourable to determining chronological questions, they were such as to afford a basis of greater certainty than could be obtained from the excavation of a cemetery. The northern hills of Tell Asmar had not been inhabited in the Larsa period, or later, while in the extreme north a large building and a group of private houses south of it had been partially uncovered It was, therefore, possible to extend the excavations over a wide area and to avoid generalisation on a single example. At the same time, stratification could be determined with certainty This latter factor is of special importance, as it was found, in working out the plan of the city, that stratification was not a mere matter of determining absolute levels Constant rebuilding of structures fallen into disrepair over a long period of time had been responsible for differences in level, sometimes of a metre or more, between buildings of the same cultural epoch A further cause of a possible confusion was the survival of archaic features into periods to which they did not belong This was found to be due to the adaptation of the ruins of older structures as supports for the new.

In two respects in particular, the season's excavations at Tell Asmar are of outstanding importance for the cultural history of early Mesopotamia—the view they afford of the conditions of life of the private citizen; and, secondly, in the new knowledge they have yielded of early phases of religious cult and belief.

The conditions of life among the ordinary citizens are revealed in the remains of the large number of private dwellings which have been uncovered. From these the excavators have been able to determine or infer the lines of a fairly complete plan of the city, and at the same time to reconstruct the typical dwelling of the Sumero-Akkadian culture So far as the private dwelling is concerned, it is noted that there appears to be no marked break in occupation with the incoming of the Sargonid era, and it continued uninterrupted down to the period of the Third Dynasty of Ur, but in the area of the large building, which Dr Frankfort considers sufficiently extensive and complex to justify the denomination 'palace', there is a period of apparent abandonment represented by about a metre of rubbish which intervenes at the close of the Sargonid period

The reconstruction of the Akkadian dwelling-places emphasises several interesting features in the arrangement and relation of the various chambers. They differ from buildings at Ur in the absence of the open courtyard Two notable additions are made to knowledge of the architectural accomplishments of this early period in the form of a window, lighting a store-room by means of a terra-cotta grille, and the use of the arch in communicating doorways. In both instances this is the earliest known example in Mesopotamia. In the 'palace' building by far the most remarkable structural feature is the sanitary system, in which, however, Dr. Frankfort notes, in the greater number of instances, the rooms are not congruous with this use

The excavation of the 'Temple of Abu', the temple of the god of fertility, has provided some remarkable material bearing upon the early form of religious belief in Mesopotamia, of which, however, the full significance is to be completely appreciated only when it is brought into relation with the cult material obtained from the private dwelling houses The unity of 'public' and 'private' cult is striking. The salient fact which emerges is that this Sumero-Akkadian religion centres around one deity; although, it is true, at this time the existence both of a great mother goddess and of a sun-god was recognised The god of fertility, however, is the central figure of the pantheon He personifies the generative forces of Nature and is closely associated with the crops and flocks and herds It follows that the various names of deities, Ninurta, Ningirsu, Abu Dumuzi (Tammuz) and the like are in reality but epithets referring to different aspects of this early deity, and tradition may have decided which aspect was to prevail in any given locality. Hence also it is clear that this fertility god was a Sumerian and not a Semitic deity. Not only was he the generative force in Nature, manifest in the fertility of the soil and the flocks, but also he lived in the netherworld, often assumed the shape of a serpent, was exposed to dangerous encounters, and vanquished monsters. From this last manifestation Heracles, it has been shown, stands in direct line of descent. The consummation of his marriage with a goddess was an essential part of the annual ritual. This ceremony was well known from other sources, but Tell Asmar has afforded on a seal the only known representation of the divine nuptials in early Mesopotamia.

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[*] Iraq Excavations of the Oriental Institute, 1932–33: Third Preliminary Report of the Iraq Expedition. By Henri Frankfort. (The Oriental Institute of the University of Chicago Oriental Institute Communications, No 17) Pp ix+92 (Chicago· University of Chicago Press, London Cambridge University Press, 1934) 7s net

Among a hoard of copper objects enclosed in a pot was a bronze open-work dagger-handle in which was wedged a fragment of the original blade This has been examined by Dr C H Desch, who pronounces it to be iron of telluric origin As it belongs to the 28th century B C, it is by many hundreds of years the earliest example known The same applies to a fragment of clear glass which has been examined by Mr Horace C Beck, who points out how surprising it is to find in Mesopotamia clear glass dating from 2700 B C, since in Egypt, although opaque glass was known in the second millennium B C, clear glass was not introduced before Roman times

It has been possible to touch only on the more striking points in Dr Frankfort's report, while the excavations at Khafaje and Khorsabad must be passed over, notwithstanding their interest and importance The excavations of the Oriental Institute closed for the season in 1933 at a point which promised much in the following season This expectation was not disappointed and the further reports of the director are awaited with interest

Three-Colour, One-Exposure Camera

THE customary method of making a set of colour-separation negatives for colour photography is by successive exposures on separate plates through the appropriate colour filters Usually three negatives are required This method fails for snapshot exposures of moving objects For many years inventors have attempted to devise three colour cameras operating with a single exposure during which all three images are simultaneously recorded Several of the optical devices which have been used to achieve this end were briefly described by Dr D A Spencer in 1933 (*Photographic J*, 74, 103, 1934) and a further method was described in 1934 (*ibid*, 74, 244, 1934) by the late Mr W T P Cunningham

One of the less difficult methods depends on the use of two inclined, semi reflecting, plane mirrors Light from the camera lens strikes the first mirror and a portion of it is deflected to form an image on one of the photographic plates placed behind its suitable colour filter; the remainder of the light goes on and meets the second mirror, which deflects a portion on to another plate, and the remainder goes on to the back of the camera where the third filter and plate are situated One objection to this method is that reflection takes place at both surfaces of each mirror and, if the mirrors are thick, double images may be formed This has led to the use of thin pellicle mirrors which are said to have been suggested by Geisler so long ago as 1910 (see Spencer, *loc cit*) and have recently been made as commercial articles by Mr H O Klein It is said that other ways of avoiding double images with this general arrangement of semi reflecting mirrors are also available.

The method has therefore led to considerable practical success and at present there are available two cameras which make use of it These were both shown at the recent British Industries Fair One is the Taylor Hobson three colour camera (Vivex system) and the other is the Klein tri-colour camera invented by Adrian B Klein and manufactured by Messrs Bellingham and Stanley, Ltd These cameras are said to work successfully to give exposures ranging from 1/25 sec to 1/10 sec in winter sunshine Inquiries about these cameras should be addressed, in relation to the first to Messrs Colour Photographs (British and Foreign), Ltd, Victoria Road, Willesden, N W 10, and in relation to the second to Messrs Farquhar and Moloney, 15–16 Newman Street, London, W 1, or to Messrs Bellingham and Stanley, Ltd, 71 Hornsey Rise, London, N 19

A Japanese Scientific Expedition to Manchoukuo*

THE Japanese have lost no time in examining the resources of the new 'independent' kingdom of Manchoukuo, and in October and November of 1934 were published in Tokyo the early sections of a report upon the first Japanese scientific expedition to the country, which carried out exploration work with the aid of motor transport and some aeroplane reconnaissance during the period June to October 1933. Under the leadership of the geologist, Prof Shigeyasu Tokunaga, of Waseda University, thirteen scientific workers representing geography, botany, zoology and anthropology were dispatched from Japan, largely through the influence of Viscount Toki, Vice-Parliamentary Secretary of the War Office. Never before has a scientific expedition been dispatched abroad from Japan on so big a scale The reports now published are in Japanese with a very full transcript in English, which manages to express some of the enthusiasm with which the expedition has undertaken its task, regarded as important both on patriotic and scientific grounds.

Before leaving Tokyo on July 22 the members of the expedition assembled in Tokyo in front of the 'Niju Bashi' (bridges at the entrance of the Palace) and worshipped at the entrance of the Palace; by July 30 they were in Hsin-king, the capital of Manchoukuo, and there they met again on October 12 "amidst the tear-prompting, enthusiastic welcome of the Government officials as well as plain people". On October 11 in the presence of Viscount Toki "the expedition drank to the happy completion of the scientific investigations at the risk of lives" During the intervening seventy days, some 5,000 kilometres had been covered in automobiles over trackless country; "the bottoms of the rivers are rather shallow [elsewhere described as "abdomen-deep"], yet the quagmire-bed so deep The treacherous rivers!" So far as possible they drove along the dry beds of rivers, but frequent storms, which in Jehol turned scorching summer to bitter cold, often delayed or prevented a projected tour. 'A proverb goes 'a precipice in front, a wolf behind', when our march was impeded, we could not safely stay where we were because of there being a danger of bandits' assault". The expedition's work was done under escort of thirty soldiers and occasionally under additional protection from garrisons.

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* **Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga, June–October 1933 Section 1: Natural Science Research of the First Scientific Expedition to Manchoukuo. By Shigeyasu Tokunaga Pp iii+76+69 plates Section 4, Part 1: Plantæ Novæ Jeholenses, I By Takenoshin Nakai and Masao Kitagawa. Pp iv+71+20 plates Section 5, Part 1 The Fresh Water Fishes of Jehol. By Tamezo Mori Pp ii+61+21 plates. (Tokyo Waseda University, 1934)**

Dirty and scarce drinking water, and 'horribly poisonous insects", with the concomitant troubles of dysentery, trachoma, etc., were probably greater difficulties than the bandits, who only fired upon a camp on one occasion. An endemic epidemic goitre was found to be widespread in south-western Jehol.

The preliminary scientific results are summarised by the head of each section in the first general report (October 1934). A brief stratigraphical summary reports abundant fossil *Lycoptera* and many fossil insect larvæ (*Ephemeropsis*) in lower Cretaceous rocks. In loess strata of Middle Pleistocene age, remains of *Ovis* and *Elephas* included bone pieces apparently engraved by ancient man. Jehol was a nomad zone originally occupied by Mongolians; during the Shin dynasty, these Mongolians had declined in prosperity and the Hans (Chinese in the Han dynasty) emigrated there. In the northern district of Manchoukuo the Mongolians still predominate, and throughout the country three systems of farming can be traced, the North Chinese, Manchurian and Mongolian. The animals found still recall the forests, which have been ruthlessly despoiled since the Hans. The November report (Section 4, Part 1) figures and describes eight species of new woody plants (by Dr. T. Nakai) and twenty-nine new herbaceous plants (by Dr. T. Nakai and M. Kitagawa).

Section 5, part 1, consists of an account of the freshwater fishes of the province of Jehol. This province—a highland area occupying the south-western part of Manchoukuo and contiguous with the north-eastern border of the Chinese province of Hopei (Chili)—is irrigated by the upper reaches of several rivers in the waters of which and those of associated lakes and ponds 783 fishes were collected. These comprised 33 species and one sub-species representative of the two families Cyprinidæ and Ophicephalidæ. The detailed taxonomic descriptions are accompanied by twenty-one beautifully produced plates in which all the species are carefully figured, some of them in colour.

Lubricating Value of Mineral Oils

IN 1929, under the auspices of the Department of Scientific and Industrial Research, a paper (Lubrication Research, Technical Paper No. 1) by the late Sir William Hardy and M. E. Nottage on the analysis of commercial lubricating oils by physical methods was prepared. It was considered, however, inadvisable to draw conclusions from the results of experiments reported therein, since only two oils, and those of unknown origin, had been employed. A further paper by Miss Nottage recently published under similar conditions (Lubrication Research, Technical Paper No. 2. London: H.M. Stationery Office. 9*d*. net) entitled "A Study of the Boundary Lubricating Value of Mineral Oils of Different Origin" is intended in certain respects to supplement the original one.

When the film of lubricating oil separating two smooth bearing surfaces is so thin that no part of it is beyond the range of cohesive forces of attraction transmittable from these surfaces, boundary conditions are said to prevail. Interposition between the two surfaces of a film of oil may, to some extent, neutralise these conditions or, in other words, boundary lubrication may be employed. In these circumstances two important factors must be taken into consideration: the effect of the surface on the oil, hence the nature of the bearing surface, since chemical activity occurring at an interface differs materially from that occurring in bulk; and chemical properties of the lubricant, the function of which of neutralising the cohesive forces of attraction is effected by the formation of adsorptive layers on the bearing surfaces.

Inasmuch as mineral lubricating oils consist of inactive, non-polar constituents and surface-active polar constituents, from which the greater part of the adsorptive layer is formed, the properties of the film may differ considerably from properties of the oil in bulk. Important factors determining friction-reducing properties of the adsorptive layer are the chemical nature of the constituents and their degree of dispersion. This, in turn, may be varied by changes of temperature, the presence of other substances which play no part in reducing friction, or the solution of oil in certain volatile solvents.

Having regard to the important part played by wax in mineral oils, concurrent investigations were made to obtain some indication of its rôle in a lubricant under boundary conditions. It is shown that, in spite of the general view that wax is detrimental to a lubricant, it does, in certain cases, enhance the lubricating value of the oil at the boundary layer.

University and Educational Intelligence

CAMBRIDGE.—At St. John's College a research studentship and research exhibitions are offered for competition in July 1935. One Strathcona research studentship of the annual value of £150 is offered for competition among research students who are graduates of any university other than Cambridge. Two Strathcona exhibitions of the annual value of £40 are also offered for competition under the same conditions as the studentship.

Grants from the Worts Fund have been made as follows:—£75 to D. B. Keith, A. B. Whatman, and J. W. Wright towards the expenses of an expedition to survey the north coast of North-East Land (Spitsbergen); £120 to P. T. Cotton, D. W. Ewer and L. E. R. Picken towards the expenses of an expedition to investigate the freshwater ecology of the south-west Balkans; £50 to T. T. Paterson towards the expenses of an expedition to the North-West Frontier of India for the purpose of studying quaternary deposits; £26 10*s*. to J. R. B. Stewart for archæological investigations in Asia Minor; £25 to Dr. T. C. Phemister towards the expenses of a geological and petrological survey of the Coast Range batholith of British Columbia; £25 to T. G. Tutin for a visit to the Mediterranean coast of Spain to study the destruction of the eel-grass, *Zostera marina*; £25 to K. H. Chapman for an expedition to Morocco to study the Moroccan locust, *Dociostaurus morocannus*.

J. H. Lockhead, of Christ's College, has been nominated to use the University's table at the Zoological Station at Naples.

LONDON —Mr R O Kapp has been appointed as from March 1 to the Pender chair of electrical engineering tenable at University College.

THE Board of Education is prepared, as in recent years, to consider applications for full-time studentships from teachers in England and Wales with at least five years teaching experience who desire financial assistance to follow courses of advanced study at universities or other institutions at home or abroad Particulars of the awards and application forms are obtainable from the Board of Education, Whitehall, S W 1

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Council of the Institution of Electrical Engineers Further particulars can be obtained from the Secretary of the Institution, Savoy Place, London, W C 2 Duddell Scholarship, valued at £150 a year and tenable for three years, open to British subjects under nineteen years of age on July 1, 1935, who wish to take up a whole time day course in electrical engineering , Ferranti Scholarship, valued at £250 a year and tenable for two years, open to British subjects under twenty six years of age on July 1, who desire to carry out whole-time research or post-graduate work in electrical engineering Swan Memorial Scholarship, valued at £120, and for one year, open to British subjects under twenty seven years of age on July 1, who desire to carry out whole-time research or post-graduate work in electrical engineering Silvanus Thompson Scholarship, valued at £100 a year and tuition fees, tenable for two years, for works employees, open to British subjects under twenty-two years of age on July 1 , the successful candidate will be required to take up a whole time day course in electrical engineering at an approved university or technical college

FROM Heriot-Watt College, Edinburgh, we have received a brochure signalising the completion and opening, in January, of the first section of an important extension of the College buildings, planned, in conjunction with the Town Council, in 1928 The second section, to be completed, it is hoped, in 1936, has already been begun, and the governors propose to make now an appeal for the sum of £100,000 to finance the construction and equipment of the final section The appeal will be associated with the celebration of the fiftieth anniversary of the assumption by the College of its present name and functions Prior to 1886, the institution was concerned mainly with evening classes for young persons employed during the day in earning their living, and without any other means of advancing beyond the standards of education of the elementary schools The pamphlet gives, in addition to full particulars of the extension scheme, a very interesting account of the stages through which the 'School of Arts', founded in 1821 by Leonard Horner (afterwards first principal of University College, London), gradually reached its present status—that of an affiliated college of the University of Edinburgh, preparing students for careers in mechanical, electrical, mining and oil engineering, applied chemistry, brewing, pharmacy, building and printing and conducting evening classes in commerce. Special prominence is given to the amplitude, due in large measure to the exertions of the late Edward Clark, of the equipment of the printing school for the teaching of all phases of book production.

Science News a Century Ago

Chemistry of the Sea

The chemical composition of sea and mineral waters was being actively investigated by Dr Daubeny in the years 1835-37 In his manuscript 'Note-book of Experiments" he records, "March 25th Having brought from Naples a bottle containing the residuum of 2 gallons of the sea water taken off the Island of Ischia evaporated till there remained only 6 ounces, I tested it for Bromine . I obtained 5 1 grains of silver precipitate—chiefly bromide " From previous analyses it appeared that there is an almost exact correspondence between the quantity of bromine present in the sea water off Southampton and off Naples

Temperature of Fishes

Dr John Davy (1790 1868), the brother of Sir Humphry Davy, became an army surgeon and rose to the rank of inspector-general of army hospitals. He was eminent as a chemist, geologist and physiologist, and in 1834 was elected a fellow of the Royal Society On March 26, 1835, he read a paper to the Royal Society "On the Temperature of some Fishes of the Genus Thunnus" He said that many years before he had observed that the bonito had a temperature of 99° F when the surrounding medium was 80 5° F and that it, therefore, constituted an exception to the general rule that fishes are universally cold-blooded Having found that the gills of the common tunny of the Mediterranean were supplied with nerves of unusual magnitude, that the heart of this fish was very powerful and that its muscles were of a dark red colour, he was led to conjecture that it might, like the bonito, be also warm-blooded, and this opinion was corroborated by the testimony of several intelligent fishermen In the course of his paper he endeavoured to extend the analogy to other species of the same family which, according to the reports of the fishermen of whom he made inquiries, have a high temperature and in the internal structure of which he noticed the same peculiarities as in the tunny, namely, very large branchial nerves, furnished with ganglia of considerable size

Faraday on the Manufacture of Pens

On March 27, 1835, Faraday lectured at the Royal Institution on the manufacture of pens A report of the lecture was given in the *Records of General Science* of May 1835 Quills, Faraday said, appear to have been employed at least as early as the seventh century England was supplied with the article from Russia and Poland, where immense flocks of geese were kept for the sake of their quills Twenty million quills were imported into England from those countries in 1834. A wing of a goose produced about five good quills, and by proper management, a goose might afford twenty quills during the year The preparation of quills was a nice process of which, up to seventy years previously, the Dutch had had a monopoly A pen cutter would cut about 1,200 quills a day A house in Shoe Lane cut annually about six million Steel pens for writing were first made by Mr. Wise in 1803, and were fashioned like goose pens A patent was taken out in 1812 for pens with flat cheeks, and in this way all metallic pens were made for some time, as the rhodium pen of Dr Wollaston and the iridium pens of others About twelve years previously, Mr. Perry began to make pens, and about six years after that they were manufactured in Birmingham. Faraday described the processes employed in the making of steel pens and said that, from information given him, the total quantity of steel used in Great Britain for pen-making was 120 tons. When first introduced, steel pens were 8*s.* a gross, but recently they had been manufactured at 4*d.* a gross. It appeared that the only interest that had suffered by the employment of steel pens was that of the pen-knife makers.

Samuel Clegg and the Gas Industry

In the *Mechanics' Magazine* of March 28, 1835, is a contribution from "L. L." on "Materials for a Memoir of Mr. Samuel Clegg, and Authentic History of the Art of Gas Lighting". Samuel Clegg, the elder, was born in 1781 and died in 1861, and "L. L." described himself as one of his earliest and oldest friends. Clegg learnt the art of gas-making from Murdoch at the works of Boulton and Watt. In 1805 he set up a small gas plant at his mother's house in Manchester, and in the following year installed gas lighting in some of the Lancashire factories. He was the first chief engineer of the Gas Light and Coke Company and he was the first to invent a gas meter. In the course of his article "L. L." said: "In 1814 Mr. Clegg superintended the fitting up of the pagoda in St. James's Park. This splendid display of the power of gas illumination was exhibited to the Royal family on the evening previous to the night when it was burned down by the fireworks. The pagoda was an octagonal figure, 80 feet high from the bridge. At each angle there was a pipe running the whole height, with a small hole drilled every two inches, through which gas issued, and opposite each of the lowest holes in the perpendicular pipes was placed an oil lamp, concealed by a piece of sheet iron, so that when the gas was turned on, the first flame was ignited by the oil lamp, and each gas flame lighted the one immediately above it all the way to the top. This gave the whole the appearance, when first lighted, of so many rockets ascending into the air. There certainly never was anything so beautiful before, and it is likely that there never may be again."

Societies and Academies

LONDON

Royal Society, March 14. M. L. E. Oliphant, A. E. Kempton and Lord Rutherford: The accurate determination of the energy released in certain nuclear transformations. If changes of mass are taken into account, the law of conservation of energy holds closely for the transformations of the isotopes of lithium when bombarded by ions of ordinary and of heavy hydrogen. The masses of Li^6 and Li^7 are found to be 6·0143 ± 0·0002 and 7·0148 ± 0·0002 respectively, in good agreement with the mass spectroscopic values 6·0145 ± 0·0003 and 7·0146 ± 0·0006 found by Bainbridge. By application of the laws of conservation of momentum and energy, the mass of the hydrogen isotope of mass 3 is found to be 3·0152 ± 0·0002. Attention is directed to the factors involved in determining the mean ranges of expelled particles and to the difficulties of interpretation when more than two particles are emitted in a single transformation. While there is good agreement in the case of lithium, which involves the masses of particles measured in terms of helium, a number of nuclear reactions in beryllium and other elements show large discrepancies on the accepted mass scale. These reactions, as well as those in lithium, can be brought into line by assuming a small error in the helium oxygen ratio. H. J. Taylor: The tracks of α-particles and protons in photographic emulsions. α-particles and protons give tracks in photographic emulsions, which are visible, after development, as rows of grains in straight lines. These tracks have been studied, using special emulsions more suitable for such work than those commercially obtainable. Exposure of a plate to a neutron source gives rise to well defined tracks, which are due to the protons ejected by the neutrons in their passage through the gelatine of the emulsion. The method is, however, unsuitable for quantitative study of neutron energies.

PARIS

Academy of Sciences, February 4 (*C.R.*, **200**, 429–500). The president announced the deaths of Charles Flahault, non resident member, and of Theobald Smith, *Correspondant* for the Section of Rural Economy. B. Havelka: The curves in Euclidian space of *n* dimensions the curvatures of which are connected by linear relations with constant coefficients. Jean Louis Destouches: Conditions to be imposed on a physical space and the generalisation of Poincaré's definition of the number of dimensions. Henri Roure: The calculation of a periodic solution in the perturbation of Pluto by Neptune. F. Tesson: A liquid microcathetometer. The distance between two vertical points is measured by running water from a microburette into a circular trough containing water covered with a layer of oil. Contact with the point can be determined to 0·001 mm. and, by arranging a suitable area for the section of the trough, this corresponds to the addition of 0·02 c.c. of water. Amédée Guillet: The measurement of the moment of a couple by the use of the chronometric motor. Application to the study of viscosity. Marcel Chrétien: A new apparatus for the restitution of aerial photographs. Léonard Sosnowski: The radioactivity excited by neutrons in platinum. The neutrons in the experiment described were obtained from irradiated beryllium. Platinum, after 15 hours exposure, gave a radiation which from its rate of decay and absorption on passing through aluminium, would appear to be due to β-particles. Pierre Auger and A. Rosenberg: The secondary effects of the cosmic rays. Francis Perrin and Walter M. Elsasser: The theory of the selective capture of slow neutrons by certain nuclei. Pierre Montagne: The calculation and graphical representation of the elementary displacements in the reactions of homogeneous chemical equilibrium. Variation of the concentrations. Reactions at constant volume. Raymond Lautié: The molecular weight of a pure liquid at its normal boiling point. Paul Laffitte and Pierre Grandadam: The oxides of platinum. The authors have previously described the preparation of a mixture of the two oxides PtO and PtO_2 by the direct action of oxygen at high pressure and at a high temperature on platinum. The dioxide was isolated from this mixture and in the present communication the isolation of PtO is described. Hydrogen reduced PtO instantaneously at the ordinary temperature. The mixed oxides act as a very active catalyst in the hydrogenation of certain organic compounds **FÉLIX TROMBE**. The isolation of gadolinium. The gadolinium is separated by electrolysis of its chloride in the presence of cadmium the cadmium is afterwards removed from the gadolinium by distillation in a high vacuum **MARCEL CHÂTELET**: A transition compound in the formation of complex compounds of trivalent cobalt **PIERRE FRÉON** The preparation of α-aldehyde alcohols The Grignard reaction takes place normally with α isonitrosoketones, and the aldehyde alcohol $C_4H_9C(CH_3)(OH)CHO$ has been prepared by this method **GERARD DESSEIGNE** The condensation of isopropyl alcohol with toluene and some substitution derivatives **GEORGES DARZENS** and **ANDRÉ LÉVY** The synthesis of a methylmethoxytetrahydronaphthalenic acid, the corresponding naphthalenic acid and of 1 7 methylnaphthol **GEORGES MIGEON** The proportion of water and the dehydration of sepiolites **V BABET** The first fossil molluscs collected in French Equatorial Africa, in the formations of the interior basin of the Congo **JOSEPH BLAYAC**, **RODOLPHE BOHM** and **GASTON DELÉPINE** The age of the Lydian horizon of the base of the Carboniferous of the Montagne Noire **ALBERT ROBAUX** The presence of the Upper Cretaceous at the base of the Flysch series of the south of the province of Cadiz **E FOURNIER** The experiment with fluorescin at the Paradis gulley (Doubs) The fluorescin test showed that the water from this gulley appeared at four outlets, taking from three to eight days to travel **JEAN CUVILLIER** The distribution and stratigraphic value of *Nummulites uroniensis* in Egypt and in the Mediterranean basin **FRON** and **MONCHOT** The influence of certain derivatives of quinoline on vegetation The neutral sulphate of ortho-oxyquinoline (cryptonol), which is known to possess a powerful anticryptogamic action, when added in suitable proportions to soil, hinders the development of injurious fungi and does not reduce the fertility of the soil **ARON POLACK** The disadvantage of didymium in optical glasses **YVES LE GRAND** The measurement of acuteness of vision by means of interference bands **A DORIER** The passage to latent life of the larvæ of the Gordiaceæ **HENRI HEIM DE BALSAC** The line of demarcation between the Berber and Saharan fauna in North Africa Its ecological determinism **JAMES BASSET**, **MICHEL MACHEBŒUF** and **JEAN JACQUES PEREZ** Studies on the biological effects of ultra-pressures Modification of the antigenic specificity of serums under the influence of very high pressures **MICHEL FAGUET**: The photometric study of microbial multiplication.

LENINGRAD

Academy of Sciences (*C.R.*, 4, No 7) **A MAYER** and **E LEONTOVICH**. Some inequalities relating to Fourier's integral **I. VERCHENKO** and **A KOLMOGOROV**: Further investigations on the point of inflexion of functions of two variables **L RADZISHEVSKIJ**: A method for investigating certain classes of integral equations and of systems with an infinite number of unknown quantities **A. POPOV**. Some types of series **J SEDOV** and **A. FILIPPOV**. Optical dissociation of indium bromide and indium iodide. **L. GROSHEV**: The spectral distribution of photo-electric current in salts dyed by colloidal copper. **S. ARTSYBYSHEV**, **L MILKOVSKAJA** and **M. SAVOSTJANOVA**: The influence of illumination on the formation and destruction of colloids of sodium in rock salt. **A. PETROV** and **T. BOGOSLOVSKAJA**: Problem of the chemistry of voltol oil formation. **G TARASOV** Polymerisation of liquid hydrocarbons under the action of electric discharges. **P BUDNIKOV** and **L GULINOVA** Methods for the determination of active silica in pozzolanic substances **M BRIK**: A find of Lower Triassic flora in Central Asia **N FILIPJEV**. Lepidopterological notes (16) A case of nomenclature

SYDNEY

Royal Society of New South Wales, December 5. **ADRIEN ALBERT** *Myoporum Deserti* a preliminary investigation *Myoporum Deserti*, otherwise known as dog-wood poison bush, Ellangowan poison bush, turkey-bush, etc, has been long suspected of being toxic to cattle The fruits and the leaves contain a poisonous substance, probably of a glucosidic nature, which could not be isolated during the present work, but leaves and extracts of the leaves tested at Glenfield Veterinary Research Station have confirmed the toxicity of both leaves and fruits to calves and sheep. One pound of air dried leaves was fatal to the latter A small amount of volatile oil containing an unidentified ketone was obtained from the leaves. **J C. EARL** and **G H MCGREGOR** A chemical examination of blackfellows' bread, the sclerotium of the fungus *Polyporus mylittæ*, Cke and Mass The material was examined by acetylation and by degradation of the acetate with methyl alcoholic hydrochloric acid The acetate closely resembled cellulose triacetate except that the specific optical rotation was slightly high The principal degradation products were the methyl glucosides, but there was evidence of the presence of some other methyl glycoside By direct acid hydrolysis of the original material, a solution containing glucose and some ketose sugar was obtained The quantities of nitrogenous and ether-soluble substances present were low **J W HOGARTH**: A note on the decomposition of cobalt amalgam A new cobalt amalgam, prepared by electrolysis of cobalt sulphate with a mercury cathode, at a high current density, when exposed to the air is rapidly oxidised to what appears to be a suboxide of cobalt This latter substance is a fine, intensely black powder, yielding some hydrogen on treatment with dilute acid, and neutral water on reduction with hydrogen **T H HARRISON** Brown rot of fruits and associated diseases of deciduous fruit trees (2) The apothecia of the causal organisms In continuation of his studies of the taxonomy of the brown rot fungi, the author presents a comprehensive account of the apothecial stage of the three common species of brown rot fungi, namely, *Sclerotinia fructigena*, Ader and Ruh, *S laxa*, Ader and Ruh., and *S fructicola* (Wint), Rehm A further record of each of the first two species is presented Comparative studies of all three are reported and discussed **V. M. TRIKOJUS** and **D E White**. Chemistry of the constituents of the wood-oil of the 'callitris' pines (2) Guaiol. Guaiol, from *C intratropica*, $C_{15}H_{26}O$(i), on oxidation with potassium permanganate yields the dihydroxyether, $C_{15}H_{26}O_3$(ii), obtained by previous workers, and a substance, $C_{15}H_{24}O_3$, the function of the oxygen atoms being undetermined (i) on oxidation with percamphoric acid gives $C_{15}H_{26}O_2$ in quantitative yield, a further indication of the presence of a double band or labile third ring in (i) The action of bromine (1 mol.) on (i), followed by hydrolysis, gives good yields of an inseparable mixture of $C_{15}H_{24}$ and $C_{15}H_{24}O$, which reduces catalytically to a mixture of the corresponding dihydroderivatives Oxidation of guaiene, dihydroguaiene, or (ii) has not led to positive results. Elinor S Hunt A summary of changes noted in the allantoic membrane of the chick in 500 experiments The allantoic membrane of the embryo chick was prepared in the manner described by Moppett (*Proc Roy Soc* (B), **105**, 402; 1929) and exposed for periods varying from 2 hours to 6 days to the radiation from a 3 mgm. radium needle A comparison with controls exposed over a blank needle case clearly demonstrated a radiation effect for the longer exposures It was thought that mere exposure had a sensitising effect since many of the controls showed abnormalities An extended investigation with control specimens gave no evidence of infective changes but the incidence of abnormal specimens was greatly reduced by 'sheltering' the exposed area by placing face down on cotton-wool

(To be continued)

Vienna

Academy of Sciences, January 10 Erwin Kosak The variability of corresponding differences of meteorological elements and its application to climatological problems Gertrud Perl True solar radiation at different geographical latitudes The results of measurements of the intensity of the sun's radiation at eighty stations distributed over the earth's surface are summarised, and from them the mean diurnal course of the intensity is derived for the months of March, June, September and December Karl Mayrhofer Real partial fraction series Rudolf Inzinger A geometry of the line elements of the first and second order of space Theodor Pintner The tissues of cestodes

January 17 Leopold Schmid and Hugo Körperth: Amber (3) The insoluble succinin remaining after treatment of amber with alcohol constitutes the principal component of this resin On dehydration it yields pimanthrene (1 7-dimethylphenanthrene) and agathaline (1 2 5 trimethylnaphthalene) Max Toperczer Knowledge of the earth's magnetic field derived from the results of the magnetic survey of Austria in 1930 (1) The potential-free part Rudolf Allers · Certain differences between monocular and binocular vision and mental influence on the organ of sight Max Beier The mode of life of *Ochthebius quadricollis* subspec *steinbuhleri*, Rtt. (Col Hydroph) Erwin Schadendorff and August Verdino. Condensations of cholesteryl chloroformate with alcohols and phenols

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, March 24

British Museum (Natural History), at 3 and 4 30 —G Tandy "Plant Life of the Sea" *

Monday, March 25

British Museum (Natural History), at 11 30 —G V Seccombe Hett "Caribou" *

Victoria Institute, at 4 30 —D Dewar "A Critical Examination of the Supposed Fossil Links between Man and the Lower Animals"

Royal Geographical Society, at 5 30 —G. M Dyott. "Indians of Ecuador" (Geographical Film).

Royal Society of Arts, at 8 —J Grantham · "Research in the Cultivation of Raw Rubber" (succeeding lectures on April 1 and 15)

Tuesday, March 26

Royal Aeronautical Society, at 6 30 —Annual General Meeting

Royal Photographic Society (Scientific and Technical Group), at 7 —Annual General Meeting.

Dr D A. Spencer "The Accuracy Attainable by Straightforward Colour Reproduction (2) Filters for Subtractive Colour Photography"

Wednesday, March 27

British Psychological Society (Medical Section), at 8 30 — (at the Medical Society of London, 11 Chandos Street, Cavendish Square, W 1) —Dr J D Unwin 'Sex Regulation and Culture"

Thursday, March 28

Royal Society, at 11–1 and 2 15–4 —Discussion on "The Origin and Relationships of the British Flora", to be opened by Prof A C Seward

Institution of Civil Engineers, at 6 —Major M Hotine "Surveying from Air Photographs"

Friday, March 29

Royal Institution, at 9 - Lord Rutherford "The Neutron and Radioactive Transformations"

Institute of Physics, March 28–30 —Conference on Industrial Physics, entitled "Vacuum Devices in Research and Industry", to be held at the University of Manchester

Prof W L Bragg President *

The Faraday Society, March 29–30 —General discussion on "The Structure of Metallic Coatings, Films and Surfaces" Introductory paper by Dr C H Desch

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research Index to the Literature of Food Investigation Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies Vol 6, No 1, March Pp v+309 (London H M Stationery Office) 5*s* net

The Physical Society Reports on Progress in Physics Pp iv+371+2 plates (London Physical Society) 12*s* 6*d* net to non-Fellows

OTHER COUNTRIES

Journal of the Indian Institute of Science Vol 17A, Part 10 On the Nature and Extent of Periodic Fluctuations in certain Soil Constituents By A Sreenivasan and V Subrahmanyan Pp 113–126 1 2 rupees Vol 17A, Part 11 On the Characterisation of Different Amylases By K Venkata Giri Pp 127–129+2 plates 8 annas Vol 17A, Part 12 Contributions to the Study of Spike-Disease of Sandal (*Santalum Album*, Linn), Part 16 Distribution of Arsenic in Sandal-Wood treated with Sodium Arsenite By A V Varadaraja Iyengar Pp 131 139 14 annas Vol 17A, Part 13 The Estimation of Chlorine in Water by the *o* Tolidine Method By S D Sunawala and K R Krishnaswami Pp 141–151 1 rupee Vol 17A, Part 14 Contributions to the Study of Spike Disease of Sandal (*Santalum Album*, Linn) Part 17 Hydrogen-Ion Concentration and Buffering Capacity as Factors of Disease Resistance By M Srinivasan and M Sreenivasaya Pp 153–164 1 rupee Vol 17A, Part 15 Estimation of Tannin in Plant Materials, Part 1 *Cassia auriculata* By N Srinivasan Pp 165–173 14 annas Vol 17A, Part 16 Raman Effect in certain Derivatives of Cyclohexane By G V Novgi and S K Kulkarni Jatkar Pp 175–187 1 2 rupees Vol 17A, Part 17 Raman Effect in some Terpenes By G V Novgi and S K Kulkarni Jatkar Pp 189–196 12 annas Vol 17A, Part 18 Determination of Carbon in Soils By V Subrahmanyan, Y V Narayanayya and Miss K Bhagvat Pp 197–215 1 8 rupees Vol. 17B, Part 6 The Potential of Dry Cells with Magnesium Chloride Electrolyte By V L R Vepa. Pp 101–105 10 annas (Bangalore Indian Institute of Science)

CATALOGUES

Hilger Catalogue F Spectroscopic and other Accessories Pp. 54 (London Adam Hilger, Ltd)

Price List of Beakers and Flasks in Highly Resistant Glass. Pp. 12 Surplus Stock (Pamphlet No 88 101K) Pp 12. (London A Gallenkamp and Co., Ltd)

Absorptiometer for Liquids designed by Moll, Burger and Reichert (Aso 34) Pp. 4 Non-Recording Microphotometer. (Nomi 34) Pp 2 (Delft · P J. Kipp and Zonen)

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Creative Thought and Social Service

MANY who listened to the national lecture broadcast by Dr T R. Glover on December 19 of last year on the challenge of the Greek must have recalled the plea for courage and magnanimity with which Sir Arthur Salter closed his "Recovery", and that rectorial address of General Smuts at St. Andrews on "Freedom", which should be among the enduring monuments of the literature of 1934 The adventure of the new age, the call to creative thought, to the untiring endeavour to give to every man the physical comfort, leisure and free access to all the world's rich heritage which he possesses the capacity to enjoy, demands courage and vision, but demands above all the individuality and freedom which were among the outstanding characteristics of the Greek

The note of adventure sounded in these addresses repays consideration To sustain any civilisation at a high level requires more than learning, it requires a search for new perfections, which is the element of adventure and avoids the tedium of indefinite repetition and repressing mechanisation Only the adventure of ideas and of practice conforming to these ideas can save a civilisation from decadence, and the first service that ideas can render is that of mental fertilisation —preparing the mind to receive the ideal of other types of perfection which in turn becomes a programme for achievement

This is the essential characteristic of creative thought—the provision of new ideas, new ideals, new forms of service It flourishes in an atmosphere of freedom and of adventure The real problem indeed is not that of producing great men but of producing great societies who will put up the men for the occasion, as Whitehead truly reminds us. It is just because over whole departments of life to-day the tradition of freedom is steadily weakening and individual initiative is being repressed that the world situation is so dangerous In the new experiments at government which are being tried out, the individual, as General Smuts pointed out, is more and more at a discount Individual freedom and independence of mind are essential to all real progress Without them neither science, art nor politics can flourish

This issue of freedom, the most fundamental of our civilisation, raised once again by the events of the last few years, cannot be evaded. The new forms of government which have sprung up on the Continent, and are urged elsewhere by political groups, are based on a denial of liberty, not as a temporary expedient but on principle. It is the false assumptions on which these experiments are based, not the fact of experimenting, despite the risks in experimenting by those who have not been trained in the technique of experience, that is our danger; and the warning given by General Smuts last autumn is as impressive as it is eloquent. Without freedom, "peace, contentment and happiness, even manhood itself, are not possible. 'Happiness is Freedom, and Freedom is Courage.' That is the fundamental equation of all politics and all human government and any system which ignores it is based on sand. The vision of freedom, of the liberation of the human spirit from its primeval bondage, is perhaps the greatest light which has yet dawned on our human horizon. It forms the real spur of progress, the lure of our race in its ceaseless striving towards the future. . . . Freedom should be a creative force inspiring our young men and women to noble action."

The experiments to which General Smuts refers are in some respects reactions from abuses or failures on the part of democratic or supposedly democratic institutions. They are also attempts to save the State from the untoward consequences of such abuse or failure, but in doing so they offer merely a temporary security while jeopardising our fundamental human ideals and our finest heritage from the past. Here, as so often, the deliberate search for security leads to an anæsthesia which conceals the paralysis and decay proceeding beneath the surface, all the more readily when uniformity of speech and conduct steadily limit and standardise thought.

Many dangers attend this standardisation and mechanisation of life, but few are more serious than the opportunity they afford for shallow and specious doctrines to be imposed upon masses of mankind by a few groups the interests of which are served by their propagation. The scientific worker at least should be alive to the danger which threatens him. The limitation of scientific inquiry has been experienced in the past under the domination of theology. The bondage of political theories and expediencies will prove no less deadly to scientific advance than the earlier fetters which science has long since shed, and for his own sake the scientific worker must not tamely watch their imposition. As General Smuts said in his address on February 9, read before the newly founded South African Institute of International Affairs (*The Times*, Feb. 11), "in these grave developments we see not new life for the world but rather decay, not an enrichment of the European tradition but an impoverishment, a negation of the finest and noblest insights of human spirit, and a falling back rather than an advance in the great cause of civilisation".

The man of science, however, does not stand alone. In these last few years, he has been rapidly learning to view his work in relation to society, to see it not as an isolate but as an integrated part of the functioning of society. He has seen before him whole fields of society in which his method and habit of impartial investigation might be fruitfully applied, and indeed must be applied if society is to be secure under the conditions created by the growing application of scientific discoveries in the mechanical world. These fields of work and these possibilities will disappear if the freedom of the individual continues to be restrained. The direction or rather exploitation of scientific work in the interests of a single class or of existing political theories contains the seeds of its own disaster and downfall.

Nor is this all. If humanity is to reap the full results of scientific investigations, if the knowledge thus acquired is to be turned to account in the service of mankind, above all in the wide fields of sociology and politics, science has to join hands with art. Civilisation requires beauty as well as truth, as well as adventure. Even more than science, if possible, art demands the free expression of individuality. Science, it is true, rests largely on creative thought and individual enterprise, and under modern conditions is evolving a technique of team work which ensures their full play in the concentrated attack on a definite objective.

Progress even here is thus founded upon the experience, the integration of discords, and the social value of liberty lies largely in its production of discords and stimulation of thought. Without such freedom and discord, art becomes impossible. Art is essentially, as Whitehead has said, a finite fragment of human effort achieving its own perfection within its own limits. It heightens the sense of humanity and evolves into consciousness the finite perfections which lie ready for human achievement. In its broadest sense, art is civilisation—the unremitting aim at the major perfections of harmony, the purposeful adaptation of appearance to reality. Its secret lies in its freedom.

To surrender freedom is to dry up the fountain springs of creative thought in science and art alike, and to render impossible that alliance of science and art which is probably our supreme need if the results of scientific knowledge over the widest fields not merely of the physical but also of the biological and sociological sciences are to be applied wisely and impartially, and integrated into the structure of society. Well may General Smuts's words ring in our ears an insistent call to join issue at once with all those forces which menace so fair a prospect of advance, and jeopardise the noblest traditions and heritage which have come to mankind from the great civilisations of the past.

Reviews

The Anthropology of the Near East

An Introduction to the Anthropology of the Near East in Ancient and Recent Times By C. U Ariens Kappers With a Chapter on Near Eastern Bloodgroups, by Leland W Parr Pp vii+200+3 plates (Amsterdam · N V Noord-Hollandsche Uitgeversmaatschappij, 1934)

IN 1929 Dr Ariens Kappers, director of the Central Institute for Brain Research in Amsterdam, landed in Syria as a visiting professor in the American University of Beirut There he remained for a year lecturing on "Histology and Neural Anatomy"—for it is as a neurologist that he has made his world-wide reputation At Beirut he was tempted into a new field of inquiry—that of anthropology. Amongst his students he found representatives of that welter of races which has made the Near East the despair of the modern anthropologist Near at hand were the peoples of Syria—the Lebanese, the Druses, the Alouites along the coast to the north, the inhabitants of Damascus and of other Syrian cities on the border of the desert and the bedouin Syrians He had communities of Armenians, Jews and Arabs open to him for observation Near at hand was Palestine with its puzzling mixture of human types—old and new. He took the field, callipers in hand, and succeeded in measuring 2,500 individuals, representing the more outstanding racial types To his own measurements he added those made by others To obtain explanations of the data he collected in Syria, he found it necessary to extend his inquiries until they carried him far beyond the Caspian on one hand and the Persian Gulf on the other The results of his inquiries appeared as a series of papers in the *Proceedings of the Royal Academy of Science of Amsterdam* These researches have now been systematised and form the basis of the present work—"An Introduction to the Anthropology of the Near East". A very valuable chapter has been added by Dr. L W. Parr, of George Washington University, Washington, D C, in which is summarised the results of an investigation of the blood-reactions of Near Eastern race groups.

Before attempting to indicate the conclusions reached by Dr Kappers as to the number of races he has identified in the south-western part of Asia, and the relationships in which these races stand to each other, in an evolutionary sense, it is necessary to touch on the methods he has employed for the discrimination of one race from another His method has the recommendation of simplicity He takes two measurements of the head—its length and its width—and relies on the proportion which the width bears to the length to give him an indication of race He insists, however, and all anthropologists will agree with him on this, that when a group of measurements has been made the result must not be expressed in a single figure as a mean or average but must be tabulated so that the individual measurements are expressed in the form of a 'frequency curve'.

Dr Kappers regards the form of this curve as being indicative of race Just because the Turk, the Armenian, the Lebanese, the Druses, the Assyrians, the Uzbegs, the Kirghiz of Turkestan, and the round-barrow people of England have frequency curves which fall on the same range of the cephalic scale, they must be regarded as members of the same race—to which Dr Kappers proposes to give the name of "Central Asiatic". It would be difficult to find two peoples more sharply differentiated from each other than are the Armenians of Anatolia and the Kirghiz of Turkestan If we are guided by external appearances we shall assign the Kirghiz to the Mongolian stock and the Armenians to the Caucasian stock

Dr Kappers holds that the cephalic index—the relative width of the head—is a more reliable guide to race than are outward appearances After a lifetime spent in the study of cranial characters and racial traits, I have come to an opposite conclusion—namely, that external traits are better guides to race and to degrees of racial affinity than are the relative diameters of the skull. For example, if we are to judge the race of Charles Darwin according to his head form, then we must assign him to Dr Kappers' "Central Asiatic Race", but if we judge him according to standards accepted by his fellow countrymen we must regard him as a Caucasian of the English breed.

I am certain the majority of anthropologists will agree with me that relative head diameters have not the racial values which Dr. Kappers has assigned to them I know, too, they will agree with me when I say that Dr Kappers has done anthropology an important service by the compilation and publication of his head charts—92 in number. Indeed, his book will serve better, perhaps, as an 'introduction' to the study of the cephalic index than to a knowledge of the peoples of the Near East He has also done a service by again directing attention to 'apices' or 'peaks' which appear with a certain degree of regularity in distributional curves of cephalic indices. When Dr Kappers had plotted out the cephalic index (relative head width) of 136 Armenians measured by him in Syria, he found his frequency or distributional curve rose into two strongly marked peaks, showing a preponderance of individuals at 83 and at 86 He was surprised to discover that these two peaks appeared in series of measurements made on Armenians living in lands outside Syria These peaks or apices were so constant that he felt confident they must have a significance But what significance ? Dr. Kappers seeks to explain them by supposing that the Armenians represent a fusion of two races—one in which the mean index was at 83, the other at 86

There is no reason to suppose that such a fusion has occurred, and apparently Dr. Kappers is not entirely satisfied with this explanation, for he throws out the suggestion that evolution may work on the diameters of the head, not by running up or down a graded scale of diameters but by making jumps or mutations—just as we change gear in motor-cars by a series of big changes. For example, Dr Kappers observed when the 86 peak rose to a higher level on his curve than did the 83 peak, then a third peak usually appeared towards the end of the frequency curve This third peak was situated at 89 or 90 on the scale of cephalic indices Likewise in the frequency curves representing the cephalic indices of narrow-headed peoples If the 72 apex rose above that at 76, then an additional peak or apex usually appeared at 67, towards the lower end of the scale.

Dr. Kappers also accepts gross irregularity of a frequency curve as evidence that the people, represented by such a curve, is of mixed origin. For this reason he looks on the Samaritans of Nablus, who regard themselves as pure descendants of the pre-exilic Israelites, as a people of mixed race. Dr. Parr's investigation of the blood groups of the Samaritans was also unexpected in its results. The Samaritans showed no affinity to Hebrews or to any neighbouring Eastern people. Dr. Parr explains the peculiar blood-reactions of the Samaritans as a result of prolonged inbreeding. But if inbreeding gives irregularity in blood groups, it ought to give uniformity in cephalic indices. Or is it the case that biometricians are wrong in supposing that a high degree of variation in form and structure is indicative of racial mixture ? May it not be that degree of variability may be a characteristic of a race that although genetically pure is tending to evolve into new forms ? The study of human races, as is evident from such instances, has not reached the status of a science.

Particularly interesting are Dr Kappers' observations on the Jews. Among the northern Jews—the Aschkenasim—he found a considerable degree of round-headedness, whereas among the southern Jews—the Sephardim—long-headedness is the rule The prevalence of round-headedness amongst the Aschkenasim is attributed by Dr. Kappers to an early prevalence of this form of head in Mesopotamia, from which country he derives the ancestry of the Hebrews. Also he believes that the Aschkenasim, as they had to cross Anatolia on their way to Europe, may have become further contaminated by some of the round-headed peoples of Asia Minor The Sephardim, on the other hand, he supposes to be chiefly derived from the Phœnicians or Canaanitic inhabitants of Palestine, who were long-headed and presumably were darker skinned than the people of the Exodus. Because of the high degree of variability in head breadth and also in their blood affinities, Dr Kappers has inferred that the Jews are to be regarded as a religious sect rather than as a race. Here again we meet a problem which is still a matter of debate amongst anthropologists—What is a race in the modern world of humanity ?

I would conclude this brief review by quoting the modest paragraph with which Dr Kappers ends his text:

"My only object is to give an introduction to the anthropology of one of the most interesting fields of ancient and modern history in a simple way, so that the reader who, like the author, is not mathematically trained, may get a general impression that, I hope, is not too far away from the truth " ARTHUR KEITH.

South African Mammals

The Mammals of South West Africa: a Biological Account of the Forms occurring in that Region. By Capt. G. C Shortridge. Vol 1. Pp xxv + 437 + 23 plates. Vol. 2. Pp. ix + 439–779 + 27 plates. (London: William Heinemann, Ltd., 1934.) 42*s*. net.

SOUTH WEST AFRICA—previous to the War German South-West Africa—is the dry and rather desolate land lying between the Cunene and the Orange Rivers on the north and south, the Atlantic on the west and the Kalahari Desert and Bechuanaland on the east

The coastal region, known as the Namib Desert, is practically rainless and is without vegetation except along some of the dry river beds, where there is sometimes a growth of a species of wild melon, the nama, *Acanthosicyos horrida*, and occasional examples of the very remarkable *Welwitschia mirabilis* Inland from this, the land rises a few thousand feet, and the country is better watered and supports a small white population and a considerable coloured one. In this vast and desolate territory a great number of the larger game animals, formerly so abundant in the old Cape Colony and the Free State, still survive, some of them in large numbers, and it is this that gives so much interest to the present work

Capt Shortridge, who has been for many years the director of the Kaffrarian Museum at King William's Town, has made six collecting expeditions, extending over a period of ten years, to this happy hunting ground on behalf of his own Museum and the British Museum (Natural History). He has therefore had ample opportunity for acquainting himself with the ranges and habits of the mammalian fauna of South West Africa

After a short introduction on the physiography of the country, he proceeds to enumerate the mammals, commencing with the monkeys and concluding with the pangolins The nomenclature is very carefully worked out and all the numerous subspecific races are detailed, but there are no descriptions or keys, so that the work affords little help to the traveller or resident in identifying his captures The author gives us, however, a great deal of other information as regards the native names, the distribution in South West Africa and outside, and full accounts of the habits both as observed by himself and as gathered from all previous sources available In this matter he has perhaps been too meticulous It would have saved a good deal of space if he had condensed the remarks of other authors into a general statement, for much of the quoted matter is mere iteration of the same facts, and a carefully condensed narrative embodying the information available would have been more satisfactory to the reader

Among the larger mammals still surviving in considerable numbers are the Cape hartebeest, the blue wildebeest, the gemsbok, kudu and eland, but the rhinoceros is now nearly exterminated and the elephants, which were so numerous in the early days of the Swedish hunter, C J Andersson, and his successor, Eriksson, are reduced to a few hundred head in the Kaokoveld and Caprivi region in the north of the territory

The volumes are illustrated with a number of photographs The most remarkable of these were taken by Mr J Koester from the air. They show herds of zebra and antelope galloping across the plains and give a most vivid idea of their numbers There is also a series of maps showing the distribution of the more important species, and a larger general reference map The two volumes, which are published by the assistance of a grant made by the Research Grant Board of the Union of South Africa from funds provided by the Carnegie Corporation of New York, are a worthy example of book-making art and are prefaced by a short foreword by Field-Marshal Viscount Allenby

An appendix of more than a hundred pages contains a detailed series of measurements of the various mammals collected by Capt Shortridge during his several journeys in South West Africa These would have found a more suitable place in the technical papers in which the results of the expeditions were worked out, such as the *Proceedings of the Zoological Society*, where several memoirs have appeared If this space had been devoted to descriptions and keys by which the various genera and species could have been identified, the volumes would have been undoubtedly of greater use both to the systematic zoologist and also to residents and visitors to South West Africa

The two volumes, however, do contain a great deal of information about the mammals of South Africa, and will doubtless be welcomed by many sportsmen and naturalists who visit that country.

The Algæ

The Structure and Reproduction of the Algae Vol 1 *Introduction, Chlorophyceae, Xanthophyceae, Chrysophyceae, Bacillariophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Eugleninae, Colourless Flagellata* By Prof F. E Fritsch Pp xvii+792 (Cambridge At the University Press, 1935) 30*s* net

ALTHOUGH work on the algæ has been very extensive during the last twenty years, there has been, during that period, a noticeable lack of accessible summaries of recent information This work should remedy the omission It is a comprehensive treatment of the morphology of the algæ and it gives impressive testimony both to the extent and variety of the recent work and also to the thoroughness and judgment of its author

The present volume deals with all groups except the red, brown and blue green algæ, which are to be treated in a succeeding volume. The general method of treatment adopted brings out very well the parallel development of similar and increasingly complex vegetative and reproductive structures in the different groups The details now available for the Xanthophyceæ (Heterokontæ) and, to a less extent, for the Chrysophyceæ and Dinophyceæ permit a further development of this view At the same time, more flagellate types have proved to show obvious relationships with these diverse lines of development and, as a result, the Flagellata (in the old sense of the term) have almost disappeared as an independent group. Most of the forms now fall naturally into the different algal groups.

Further, the great extension of cytological work now permits a general view of cytological problems in the algæ, while, in the light of this work, the problems relating to alternation of generations can be adequately reviewed in the forms of more lowly organisation Although Prof Fritsch disclaims any attempt to deal fully with the physiology and ecology of the algæ, it will be found that the sections dealing with these topics, though brief, are both full and suggestive Moreover, because the different main groups of algæ produce parallel growth forms and very similar structures, the distinctions between these main groups are primarily and largely physiological The nature of the pigments present, the chemical structure of the wall and of the food reserves thus become of fundamental importance and are necessarily treated in detail At the same time, this peculiar feature of the algæ makes it very difficult to relate fossil forms with any certainty to any of the groups now living, and Prof Fritsch rightly stresses the need for caution in dealing with interpretations which have been advanced

This critical and well-balanced attitude is, indeed, one of the outstanding features of the book. A second feature which will strike the reader is its thoroughness Perhaps this will be only fully apparent to those who have some claim to specialised knowledge of the algæ To these, the exhaustive lists of references will be a joy, and, it may be said, probably a revelation Although the book will certainly prove extremely valuable and will be generally welcomed as a textbook of the best type, it is much more than this One may venture to predict that as a statement of principles and as a source of information, it must long remain the standard work on the subject.

W H P

Short Notices

(1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F Harms Unter Mitarbeit von H Lenz Band 17, Teil 2 *Technische Akustik*, Teil 1 Pp xv + 538 44 gold marks Band 17, Teil 3. *Technische Akustik*, Teil 2 Herausgegeben von E Waetzmann Pp xi + 434. 36 gold marks (Leipzig Akademische Verlagsgesellschaft m b.H, 1933, 1934)

(2) *The Voice: its Production and Reproduction, a Treatise on Voice Training, Production and Reproduction* By Douglas Stanley and J P. Maxfield. Pp xii + 287 (New York: Pitman Publishing Corporation; London Sir Isaac Pitman and Sons, Ltd, 1933) 10s. 6d net

(3) *Acoustique.* Par Prof Adrien Foch (Collection Armand Colin · Section de physique, No 166.) Pp 210 (Paris. Armand Colin, 1934) 10 50 francs.

(1) THE first two volumes under notice, written by nearly twenty experts and forming a comprehensive survey of present-day knowledge of all applications of acoustics, show how acoustics has become largely a branch of electricity. In most experimental acoustical researches now, the pressure fluctuations of the sounds are first converted into electrical fluctuations by such devices as the microphone and the indispensable thermionic valve, and are then studied as purely electrical fluctuations. The general methods used are described in a 150-page section on methods of measurement which follows a theoretical section on the basic ideas used in technical acoustics. Greater detail is to be found in the sections on the microphone, telephone and loud speaker The propagation of sound in free space covers such applications as echo-sounding Propagation over longer distances is treated in the sections on broadcasting and long-distance telephony. Speech and hearing are treated in a section on medical acoustics. Musical instruments, broadcasting, sound recording and reproduction magnetically, by gramophone records and sound films, noise prevention and shock absorption all receive detailed treatment.

(2) The second work, dealing with voice, is a more advanced treatment than the earlier volume published as "The Science of Voice" (1929) For the new work the co-operation of J P Maxfield, known in Great Britain as joint author of the first serious treatment of gramophone acoustics, secures the accuracy of the physical treatment Maxfield's brief, but very clear, outline of methods used in sound measurement is well illustrated, and is followed by Stanley's treatment of voice-production, covering all aspects of vocal technique. The whole book is a serious contribution to a subject still full of unsolved problems. An excellent index is provided.

(3) Prof Foch's little volume, which forms one of the Collection Armand Colin, the aim of which is "Vulgariser sans abaisser", is an excellent well-balanced treatment of general acoustics. There is no English book of similar size and price which covers so wide a range and is so up-to-date, and the volume would be suitable for all university students of physics. Some of the mathematics is of an honours degree standard. To have covered so wide a range without being superficial is a remarkable achievement

(1) *Introduction à la théorie des groupes et à ses applications à la physique quantique.* Par Prof. Edmond Bauer. Pp. ii+170. (Paris: Les Presses universitaires de France, 1933.) 40 francs.

(2) *Microénergétique.* Par Dr. Pierre Bricout. Tome 1: *Introduction.* Pp. vii+303. Tome 2: *Les théories et les faits.* Pp. iv+429. (Paris: Gauthier-Villars et Cie, 1933.) 100 francs each.

(3) *Statistische Mechanik auf quantentheoretischer Grundlage.* Von Prof. Dr. Pascual Jordan. (Die Wissenschaft, herausgegeben von Prof. Dr. Wilhelm Westphal, Band 87.) Pp. xi+112. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1933.) 6.80 gold marks.

THE three books under review are complementary to one another in so far as they cover the whole range of quantum mechanics between them.

(1) M. Bauer's volume deals with group theory and its applications to quantum mechanics according to the methods of J. v. Neumann, H. Weyl and E. Wigner. The arrangement of the material is on much the same lines as in Weyl's well-known book, but the treatment is easier to follow and probably more suitable for students, the arguments being set out with the clarity so frequent in French books.

(2) Dr. Bricout proposes to give a complete summary, adapted to the needs of students, of the researches, both experimental and theoretical, which are the basis of the quantum theory, but group theory and its applications are excluded. When we consider the difficulty of collecting together in a volume of 300 pages all the mathematics and physics required by a student as a preparation for the study of modern quantum theory, we cannot help admiring the skill with which the author has carried out his difficult task. The second volume of Dr. Bricout's book is devoted partly to a detailed study of the principles and methods of the various forms of the modern quantum theory and a critical comparison of them, partly to a full account of the various hypotheses put forward and the experimental facts to be explained by them.

(3) The small book by Dr. P. Jordan is on a different plane, its object being to provide a purely quantum basis for statistical mechanics. The book constitutes an original and valuable contribution to the literature of quantum statistics; no one interested in this branch of quantum theory can afford to ignore it.

Moderne Physik: Sieben Vorträge über Materie und Strahlung. Von Prof. Dr. Max Born. Ausgearbeitet von Dr. Fritz Sauter. Pp. vii+272. (Berlin: Julius Springer, 1933.) 19.50 gold marks.

PROF. BORN has made a very successful attempt to give a clear statement of the outstanding advances in modern physics in a form which should be intelligible even to those of modest mathematical attainments. The book contains the substance of seven lectures given to various associations of electrical engineers in Berlin. The essential foundations for the later chapters are set out in chapters i and ii, which give brief but sufficient accounts of the kinetic theory of gases, discharge of electricity through gases and radioactivity (including isotopes). The historical order is disregarded in the next two chapters in that the idea of wave particles is introduced before the Bohr atom is discussed. The last three lectures deal with electron spin and Pauli's principle, quantum statistics and electron theory of metals, molecular structure and chemical bonds. These subjects are treated with admirable clearness. The illustrations and tables are particularly useful, and the book is well produced. It closes with some remarks on the problems that at present confront the physicist, problems the solutions of which depend largely on successful investigations of nuclear phenomena.

H. L. B.

A Key to the Stars. By R. van der Riet Woolley. Pp. viii+143+8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1934.) 5s. net.

THIS elementary sketch of the more fundamental aspects of astronomy is specially designed by the author to describe "certain knowledge" or "demonstrable results which partake of the character of laws of Nature". The latest developments of astronomy in which "speculation is still rife" are deliberately excluded, though there are occasional lapses when controversial points are discussed. On the whole, the author has succeeded in his object of giving the lay reader a clear outline of the methods used in astronomical research and of the more definitely ascertained facts which have been disclosed. He has been more particularly successful in describing some of the fundamental conceptions on which modern astrophysics is based, in two chapters on the temperatures and composition of the stars. There might, however, have been more extensive treatment of several points without violating the expressed rule against introducing speculative matter—especially as he devotes a certain amount of attention to such subjects as stellar evolution and the rotation and expansion of the universe.

Dreams in Old Norse Literature and their Affinities in Folklore. With an Appendix containing the Icelandic Texts and Translations by Dr. Georgia Dunham Kelchner. Pp. viii+154. (Cambridge: At the University Press, 1935.) 10s. 6d. net.

THE material with which the author here deals is in its special field unique. Not only do the dreams which she has extracted from Old Norse literature constitute the only record of its kind from among the old Teutonic peoples; but also they belong to both pagan and Christian times. It is thus possible to mark the change in thought implicated by the transition from one system to another. In this respect this material is probably a safer guide than the folk lore with which the author has instituted a comparison. The sources from which the material is drawn are the Elder and Younger Eddas, the prose Saga and Skaldic poetry. The original Icelandic text, with translation, of a selection of the dreams is given in an appendix, and introductory chapters add a background in a brief account of early Icelandic history and culture.

Electron Diffraction as a Method of Research*

By PROF. G. P. THOMSON, F R S.

IN 1924, Prince Louis de Broglie put forward the thesis that all material particles, and in particular electrons, have properties analogous to those of a train of waves This view, which is now universally accepted, is the foundation of 'wave mechanics', the modern theory of interatomic effects. It predicts that electrons should show diffraction effects with crystals similar to those given by X-rays For the present purpose, it is a sufficient statement of the theory to say that a beam of electrons uniform in energy is regarded as replaced by a train of waves the wave-length λ of which is given by λ = (Planck's constant h)/(the momentum of an electron) As this wave train passes through matter, each atom of the matter is the source of a scattered wavelet the amplitude of which is (very roughly) proportional to the atomic number of the atom These wavelets will interfere with one another and with the original wave exactly as the corresponding wavelets in optics, and form an interference pattern, varying in intensity from point to point, in the space behind the scattering matter De Broglie asserted that if any detector of electrons, for example, a fluorescent screen or photographic plate, be placed in this space, the distribution of electrons recorded by it reproduces exactly the interference pattern, the electrons recording themselves in large numbers where the intensity of the waves in the pattern is large, and only sparsely where it is weak

Calculation shows that $\lambda = 10^{-8}$ cm for electrons of 150 volts energy ; it diminishes as the energy increases, being about $0{\cdot}7 \times 10^{-9}$ cm for 30,000 volts, which is the order of energy used in most of the work to be described The wave-length is thus of the order of that of X-rays, but the scattering per atom is about 10^7 times as strong, corresponding to the far greater stopping and scattering power of matter for electrons than for X-rays

The first test of de Broglie's hypothesis was made by Davisson and Germer[1] using slow electrons (~100 volts), although they found an agreement with theory which was rightly taken as establishing the truth of the hypothesis, there were outstanding differences from the simple theory which later experiments have rather increased than diminished. Some of these are probably due to difficulties of technique and the extreme sensitivity of slow electrons to surface impurities, others to neglect of second order effects in the theory, but until there is better agreement with theory the experiments cannot be used with safety to investigate unknown structures

Work with cathode rays (~30,000 volts energy) is free from this objection Experiments[2] with thin films of metals (~10^{-6} cm) showed an excellent agreement in all particulars with the theory, making use of the known crystalline structure of the metals as previously found by X-rays. Once this is established, the electron waves become a new tool to investigate the structure of matter All that is necessary is that they should pass through the specimen to be studied without losing energy by inelastic collision, for this would alter the wave-length and destroy all phase connexion with the original wave * The new tool closely resembles X-ray diffraction but the two are in some respects complementary in their usefulness, for while the X-rays are deep penetrating and average over a considerable volume of matter, the electrons only penetrate a shallow layer and can detect surface peculiarities which would be swamped by the excess of internal matter if X-rays were used

A further advantage of the greater scattering is that exposure times are less Electron diffraction patterns require seconds or less, while the corresponding times for X-rays run into hours. This is important for the investigation of gases, and promises to have considerable importance in chemistry The diffraction pattern obtained from a gas, either with electrons or X-rays, consists of diffuse rings. It is due to interference between wavelets scattered from atoms *in the same molecule*, and the position and intensity of the rings depend mainly on the various distances between the atoms. Consequently it is possible to test stereochemical theories by comparing patterns calculated from them with those actually found Important work has been done on these lines by Wierl[3], Brockway and Pauling[4], de Laszlo[5] and others

Debye has used X-rays in a similar way, the theory being practically identical As compared with the crystal method of investigating the shapes of organic molecules, there is the advantage that the molecule is studied free from its neighbours' influence, and also that the effects of molecular shape are not mixed up with those of the crystal lattice As an example of the method, Wierl[3] was able to show that the benzene ring forms a plane hexagon, while cyclohexane is wrinkled Again, Hendricks and others[6] showed that in 1.2 diiodobenzene the I–C valency directions are bent out 10° from the symmetrical positions, thus leaving room for the normal I–I distance of 4.00 A., an example of 'steric hindrance'. Considerable progress has been made with determining inter-atomic distances. The table shows some of the latest results.

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* Substance of a course of four lectures given at the Royal Institution on January 15, 22, 29 and February 5

* Even so, it may be possible for interference effects to occur, but only between wavelets elastically scattered *after* the inelastic collision and originating from the same electron.

TABLE A

Link	Aliphatic $-\overset{\vert}{\underset{\vert}{C}}-X$	Ethylenic $-C\Big\langle{}^{X}_{X}$	Aromatic $\Big\rangle C-X$	Acetylenic $\equiv C-X$
C to C	1.50 × 10^{-8} cm	1.30 × 10^{-8} cm	1.41 × 10^{-8} cm	1.18 × 10^{-8} cm
C to Cl	1.76	1.74	1.69	—
C to Br	1.93	1.91	1.88	1.84
C to I	2.12	2.10	2.05	2.03

For solids which can be obtained as thin films, a very simple apparatus is sufficient. All that is needed is a beam of cathode rays limited by fine holes, a holder for the film and a photographic plate which can be lowered into place without disturbing the vacuum. Fig. 1 shows a typical diffraction pattern formed in this way. But the range of usefulness of the method is greatly increased if we can investigate surface layers on massive solids. To do so requires a more elaborate apparatus, as it is necessary to adjust the surface to the beam by moving it in the vacuum. The adjustment has to be fairly precise, for the angles of diffraction are only of the order of 1°–5°. Suitable specimens are about 1 cm. square and are carefully flatted before use. A metal specimen, if then etched, will give sharp semi-circular rings (the other half or rather more lies in the shadow of the specimen) similar to those given by a thin metallic film and characteristic of the crystal structure of the metal.

The rings are due to electrons passing through minute crystalline projections on the surface. If the surface is then oxidised, the pattern changes to rings characteristic of the oxide. In this way, for example, Cates[7] has shown that the surface layer of rust is $\gamma FeOOH$ even when the rust is black, though the bulk of the material in this case is probably Fe_3O_4. Copper[8] shows sometimes ordinary Cu_2O and sometimes another, unidentified oxide, not CuO in its usual crystalline form but perhaps an unstable modification. Silver mirrors are known to be improved by holding for a short time in the fumes of aqua regia; Dixit[9] has shown that they then become covered with a layer of Ag_2O. Many other compounds have been observed as a result of chemical reactions. In some cases they cannot be identified, for the evidence given by a ring pattern is like that given by an optical spectrum in that one cannot deduce the nature of the substance from the pattern or the spectrum, except by comparison with that of a known substance. If the presence of some compound is suspected, it can be tested for by comparing the pattern given by the specimen with that given by the compound, which can often be found by powdering some of the compound on to a very thin film of celluloid or similar substance transparent to electrons, which is then examined by transmission.

It is a rarity to find a clean surface which does not give some sort of pattern, but to get good results the surface must be carefully prepared. The chief difficulty is to reduce the 'background' due to electrons inelastically scattered. Electrons will not penetrate more than a small multiple of 10^{-6} cm without an inelastic collision, but they will go hundreds of times as far before they get so slow that they fail to affect a photographic plate. A good specimen is one which has relatively few lumps of thickness within this range.

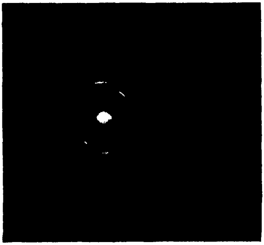

FIG. 1. Diffraction pattern of gold foil (85 kilovolts).

Just as in the case of X-rays, the sharpness of the rings is a valuable indication of the size of the minute crystals causing them. Small crystals give diffuse rings, being equivalent to diffraction gratings of poor resolving power. In practice the diffuseness becomes marked if the crystal size is less than about 10^{-6} cm. Owing to the small angles involved in electron diffraction, there is a marked difference in the effectiveness of the rows of atoms along and perpendicular to the beam, which is important in dealing with patterns such as those given by the cleavage faces of ionic crystals and indeed by single crystals generally. Unless the thickness in the direction of the beam is greater than about 10^{-6} cm. the atoms along the beam will not interfere completely, and the pattern will resemble that given by a 'crossed grating' corresponding to the array of atoms in the plane normal to the beam, rather than that given by a three-dimensional crystal (Fig 2) Since 10^{-6} is greater than the effective penetration of the electrons, the patterns given by rough (etched) crystals are all found to be of the 'crossed grating' type On the other hand, smooth cleavage surfaces can give the X-ray type of pattern since the whole surface is bathed in each electronic wave, and interference can occur between atoms on the surface any distance apart provided only that the crystal structure is perfect This last restriction is interesting because it enables one to deduce the degree of regularity of the surface from the sharpness of the diffraction pattern In some cases, for example, diamond, the structure can be shown to be regular over a distance greater than 2×10^{-5} cm , in others, for example, rocksalt, the region of regularity is less and depends greatly on the care with which the surface is prepared. There is no evidence of any inherent 'coarse structure' in crystal surfaces

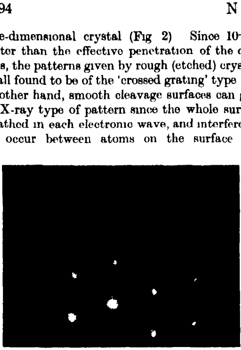

Fig 2 Diffraction pattern due to etched single crystal of copper

Another valuable test of crystal accuracy is afforded by the Kikuchi lines , these are pairs of parallel black and white lines which often appear on the photographs when single crystals are used as specimens Kikuchi[10] showed that they are caused by repeated scattering of the electrons, and that each pair lies symmetrically on either side of the line in which some plane of the crystal intersects the plane of the photographic plate. It follows that if different parts of the crystal are inclined to one another, they will give different lines, and if there is any continuous range over which the crystal directions vary, the lines will be smudged. Actually they are often surprisingly sharp, and in such cases one can say that the orientation of the crystal is perfect to 10′ or better. The lines are often poor or absent from metallic crystals, as one might expect, since the softness of these single crystals favours distortion

An interesting modification of the theory becomes necessary when dealing with diffraction by very flat surfaces. The wave-length of the electrons depends on their momentum, and changes when they enter a region at a different potential It follows from Huygen's construction that there is a refraction of the waves at entering and leaving the surface, and a consequent shift in the position of diffracted spots For cathode rays the refractive index of most substances only differs from unity by about 1 in 5,000 but, owing to the small glancing angles used, the effect is quite appreciable provided the surface is flat It is negligible if the electrons pass through roughnesses or if the glancing angle is more than about 5°. The values found for the inner potentials of ionic crystals are of the order of 12 volts (see table B) ; this is in general agreement with the mean potential which would result from the distribution of electrons in the crystals, but no accurate calculations have so far been made It is difficult to get flat enough surfaces on metals, but Darbyshire[11] has been able to show that the inner potential of zinc is 15 5 volts and of antimony about 12 volts, values which agree roughly with what is to be expected on Sommerfeld's theory of electrons in metals

Electron diffraction seems likely to yield important information as to the process of crystallisation and the mechanism of crystal growth. For example, it is found that films of metals deposited either by cathodic spluttering or by evaporation are in the form of small crystals disposed at random on the substrate. Heating to quite a moderate temperature, far below the melting point, results in the films recrystallising in such a way that some simple crystal face is more or less parallel to the surface of the substrate[12]. In some cases the orientation is almost perfect, in others not so marked. The face chosen seems to depend mostly on the temperature[8] and not on

TABLE B INNER POTENTIALS OF IONIC CRYSTALS

Substance	Density	Yamaguti	Shinohara	Dixit	Tillman	Mean
Rocksalt	2 1	7 7	6 3		7 9[1] 6 0[2]	7 0
Zincblende	4 1	12 7			12 6 12 1	12 5
Galena	7 5			12 5	14 1 13 1	13 2
Pyrites	5 0			5 1	3 8	4 4
Stibnite	4 6	11 9			14 7	13 3
Fluorspar	3 1		(Raether 15)		11 9 13 3	12 6
Calcite	2 6	12 4	13 8		12 9 12 5	12 9
Gypsum	2 3	9 1			7 9 8 5	8 5
Mica	2 9	10 6	10 4			10·5
Molybdenite	4 7	16 5 , 17 1				16 8
Graphite	2 3	11 5	(Jenkins 10 7)			11 1
Talc	2 6	12 0				12 0

Long-chain hydrocarbons (Murison) 1 3 , various organic mixtures, 8 1–7 2. PbO, 12 3 , ZnO, 12 3 , SnO, 14 2 (Jenkins). Fe_3O_4, 12 6 (Dixit)

[1] Measurements with electrons of average energy 30,000 volts [2] Measurements with electrons of 3,000–5,000 volts

the nature of the substrate unless this is closely related in crystalline structure to the film Thin films of oxide lifted off the surface of molten metal often show strong orientation, usually a tetragonal or hexagonal axis, as the case may be, is normal to the plane of the film[13] Trillat[14] has observed the *growth of thin films of metals into single crystals* under heat treatment Kirchner[15] finds that films of salts such as cadmium iodide, when deposited on celluloid by evaporation, give diffraction patterns by transmission which show that the crystals when first formed are small, but grow on standing even at room temperature, and orientate themselves

An interesting effect has been reported by Finch[16] when a surface of polycrystalline zinc is oxidised *in vacuo* The zinc oxide, which, like the zinc itself, is hexagonal in structure, appears in a modified form in which the basal plane is constricted so as to conform in size with that of zinc, there being a corresponding extension of the hexagonal axis so that the volume of the unit cell remains approximately unchanged Presumably the oxide is formed on the basal plane of zinc crystals and tries to accommodate itself to the spacing it finds I have observed[17] a different effect with a copper single crystal, a cubic structure (probably Cu_2O) appears which conforms in *direction* with the cubic structure of the copper, but has a different spacing Interesting effects occur with oxide films on the surface of molten metals Thus Jenkins[13] has shown that these take the form of small patches of oxide orientated with a crystal axis normal to the surface but otherwise at random When the lead solidifies—under the conditions of the experiment it forms a few large crystals—the oxide patches on it turn round into parallelism forming a single thin crystal, presumably under the influence of directive forces from the crystallising metal

Researches by electron diffraction in England[18] and Germany[19] have furnished proof of the existence of the layer of amorphous material on the surface of polished metals which Sir George Beilby first discovered by microscopy. If a polycrystalline metal surface is worked with abrasives in the usual way, the rings get gradually more diffuse, indicating a reduction in crystal size, until when the surface is fully polished all that remains is two very diffuse rings. These broad rings can sometimes be regarded as due to the fusing together of groups of rings which have grown diffuse, but more often they occur in the wrong position. In these cases, and, by analogy, in the others too, one must regard them as due to a truly amorphous state of the metal. The relative size of the two rings is constant (1·85 : 1) and agrees well with that found by X-rays in liquid mercury, and with the theory of diffraction by a random aggregation of spherical atoms. From the size of the rings we can deduce the diameter of the atoms In some cases this agrees well with those found from crystal structure, in others the sizes are too small, perhaps indicating an abnormal configuration of the outer electrons Finch[20] has observed that thin layers of other metals deposited on these polished surfaces disappear after a few seconds, being apparently dissolved by the amorphous layer Only after repeated deposition of the foreign metal can a permanent layer of it be formed

A research of a very different type is that made by Murison[21] on layers of grease and other lubricants He found that long-chain carbon compounds and greases when smeared on a metal or oxide surface form a structure of molecules orientated with their lengths normal to the surface The structure is pseudo-crystalline in that these long molecules have a common direction and roughly constant distance apart between their chains, but there is no lattice The orientation indicates a strong attraction for the metal surface which prevents the grease being squeezed out of a lubricated bearing, while the absence of rigid crystal form makes it possible for the molecules to bend readily past one another and so accommodate the irregularities in the surfaces to be lubricated The lubricating effect of graphite has also been studied[22], it depends on the orientation of the flakes of graphite parallel to the surfaces

The above short and incomplete account may perhaps give an idea of the kind of problem which can usefully be attacked by the method of electron diffraction Readers may be surprised at the absence of any mention of gas layers adsorbed on solids So far no effects which can be attributed to them have been observed with fast electrons It is possible that the electronic bombardment is intense enough to remove them from the surface.

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Light-Waves as Units of Length*

By DR. W. EWART WILLIAMS, King's College, London

COMPARISON OF THE RESULTS

WITH the exception of Sears and Barrell, none of the investigators seems to have realised the full implication of the fact that, while the yard or metre are purely distances, the paths observed by means of all forms of interferometers are 'optical paths', or the product of the metrical distance and the refractive index of the space concerned The two quantities only coincide when the space is a vacuum, so that if a given standard is said to contain so many waves in air, the nature and consistency of the air must be specified to such limits that its index cannot vary by an amount greater than the percentage accuracy within which the value is specified. Not only are the temperature and pressure of importance, but almost equally so the constitution and composition of the air

The primary importance of the work of Sears and Barrell lies not so much in the accuracy and thoroughness with which the investigation has been carried out, as in the fact that they have provided us with the vacuum wave-length of the red cadmium line, carrying out a direct comparison with evacuated units as well as with air It is very disquieting to find that the refractive index of air thus accurately observed is considerably different from that given by the Meggers and Peters tables[19], which is the standard conversion table in general use by spectroscopists for obtaining the vacuum frequencies of spectral lines

The humidity of the air was not observed in the earlier work of Michelson , at 15° C. the index increases by 7 parts in 10^7 when saturated air is replaced by dry air If we assume the air to have had an average humidity of 50 per cent, Michelson's value for the wave-length must be reduced by 0·0023 A to obtain the result for dry air

Neither Michelson, nor Benoit, Fabry and Perot, took account of the percentage of carbon dioxide present during their experiment. Normal 'fresh air' is supposed to contain 0·03 per cent carbon dioxide, but the amount present in a closed room may be far in excess of this due to the presence of observers. Pérard[20] has shown that an observer will contribute approximately this amount to the air of a room of 100 cubic metres capacity in the time required for a single set of observations, namely, 1½ hours. An increase of 0 03 per cent in the carbon dioxide content decreases the wave-length by 0·0003 A., so that only the more recent determinations can with strict fairness be intercompared.

The values of the wave-length of the red cadmium line in dry air containing 0 03 per cent carbon dioxide at 760 mm. pressure and 15° on the normal temperature scale are given below:

Standard No	Year	Investigators	Value in 10^{-10} metres
*26 and T_3	1906	Benoit, Fabry, Perot	6438 4703
10 and 20	1928	Watanabe and Imaizumi	6438 4682
16	1933	Sears and Barrell	6438 4708
18	1934	Kösters	6438 4672
		Mean	6438 4687

* The results have been corrected in terms of the more recent determinations of the lengths of these International Sub-standards

For the present, this is probably the best value that can be taken for the wave-length of this line in 'normal' air. It differs but little from the accepted value of 6438 4696 A., which was primarily based on the determination of Benoit and his co-workers The difference of 0 0036 A between the values of the Reichanstalt and the National Physical Laboratory seems far too great, since it amounts to almost a whole wave-length in the number of waves in the metre The discrepancy has most probably arisen in the initial comparison of the national standards with the Sèvres sub-standards The preliminary Japanese results showed a difference of 0 002 A. between the values obtained from the two standards No 10 and No 20 These were later sent to Paris for re-measurement against the international sub-standard No 26 and others The corrections of + 0·2 μ for No. 10 and − 0·11 μ for No 20 brought the wave-length values into close agreement. The result of Benoit and his co-workers has been included in the above table in spite of the uncertainty regarding the carbon dioxide content The probability is that the lengths of No. 26 and T_3 are more accurately known than those of the National Standards, and the greatest source of error undoubtedly lies in this portion.

It seems imperative that the rule prohibiting the actual use of the prototype metre itself will have to be waived, and the German and British standards be compared with it as soon as possible. The difficulty of this work can best be appreciated from Fig. 1. This photograph (reproduced by courtesy of M. Pérard) shows, with a magnification of 300, one of the fiduciary lines of the International Sub-standard No 26 which has been used in the earlier determinations The centre of the whole is supposed to be the actual position of setting, and metrologists claim that they can intercompare two standards to within ± 0·2 μ. This is equivalent to finding the centre of Fig. 1 to within ± 0·03 mm , which is clearly impossible. By reducing the magnification a sharp image is obtained, which is more of the diffraction pattern of the comparator objective than an image of the actual line itself. The result in a great measure will then depend on the conditions of illumination of the line comparator

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* *Continued from p.* 461.

It seems certain that minor systematic errors, in the optical portion, chiefly connected with the conditions of illumination of the étalons, still remain uncorrected Their effects are, however, negligible compared with the real uncertainties of line standard measurements Even at the present time, there would be a considerable gain in accuracy if a wave-length were accepted as the fundamental standard, but before a change is decided upon, it seems very desirable that the whole position should be reconsidered in the light of recent knowledge The discovery of the hollow cathode discharge by Paschen and its further development by Schuler have given us a light source that is much more monochromatic than the Geissler tube of Michelson or the argon-filled cadmium lamp as used by Sears and Barrell The further possibility now exists of finding a more suitable line from a heavier, non-isotopic element of zero nuclear spin, since we are no longer limited to the more volatile elements

Tilton[21] has recently carried out a statistical analysis of the data on the refractive index of carbon dioxide - free air, from which he deduces a correlation between the refractivity ($\mu - 1$) and the twenty-three year magnetic cycle of sunspots Some of the data are admittedly uncertain, but there seems to be evidence of a real variation that makes it essential to adopt a vacuum wave-length as the ultimate standard, if and when a change is made

For the moment, we cannot do better than accept the mean value given in the above table as the wave-length of the red cadmium line in 'normal' air, and to adopt Sears and Barrell's value, 1 000,276,49, as its refractive index The vacuum wave-length then becomes 6440·2493 A and the Imperial yard, defined as a length at 62° F , contains 1,419,818 31 vacuum wave-lengths.

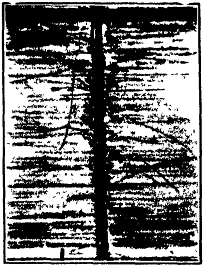

FIG 1 One of the fiduciary lines of the International sub-standard No 26 (×300)

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[19] Meggers and Peters, *Bull Bur Stand* , 14, 697 , 1918

[20] Pérard, *Proc -verb Com int Poids Mes* , p 27 , 1927.

[21] Tilton, *Bur Stand J Res* , 13, 111 , 1934

Obituary

PROF. BOHUSLAV BRAUNER

PROF. BOHUSLAV BRAUNER, one of the best-known representatives of Czech chemistry of the last half century, died in Prague on February 15, after a short illness He was born on May 8, 1855, in Prague, the son of Dr Francis Brauner, who was a noted Prague lawyer and Czech political leader His mother Augusta, a very talented and spirited lady, was the daughter of Prof K A Neumann, the first professor of chemistry at the Polytechnic Institute of Prague, and the grand-niece of the well-known German pharmacist, Prof. Caspar Neumann (1683–1737), one of the founders of pharmaceutical chemistry.

Thus Brauner seems to have inherited his liking and ability for chemistry from his mother's side. Great attention was paid in the Brauner family to languages, amongst which besides the Czech mother-tongue, Russian, English, German and French were equally cultivated. There the foundation was laid of Brauner's astonishing practical linguistic knowledge. He showed a refined taste for fine arts like the other members of his family , his sister Zdenka Braunerová being a well-known Czech painter

In 1873, Brauner went to the University and to the Technical School in Prague, where one of his teachers was the physicist Ernst Mach, at that time professor in the University of Prague Before attaining the doctor's degree, young Brauner went abroad for training in research , contrary to the fashion at that time, when "every chemist had to embark on organic chemistry", he preferred inorganic training under Bunsen in Heidelberg in 1878 Two years later, Brauner went to Manchester, attracted by the work of Sir Henry Roscoe on rare elements.

The school of chemistry in Owens College, Manchester, had a profound influence upon Brauner, who learned there to love the original Anglo Saxon spirit of experimental investigation in natural philosophy. During his years in Manchester, Brauner was eagerly investigating the rare earths, and he succeeded in preparing a double fluoride of tetravalent cerium and potassium which on gentle heating gave off free fluorine, thus for the first time obtained by purely chemical means. Fourteen years later, he found a similar reaction with lead tetrafluoride

Fascinated with Mendeléeff's system, Brauner entered into scientific correspondence with the genial Russian chemist in 1881 and was greatly impressed by meeting him in St Petersburg There a cordial friendship between the two enthusiastic Slavonic chemists began, to last for twenty-five years, until the death of Mendeléeff

A problem which occupied Brauner's mind for a long time was the position of the rare earth elements in the Periodic System. As a strong adherent of the tabular form of the system, he expected that these elements would somehow fit in so as to show their chemical analogies By determining carefully their atomic weights, he was already able to predict the gap between neodymium and samarium. In his investigations at Manchester, Brauner succeeded in showing the complexity of didymium, denoting by Diα and Diβ what Auer von Welsbach three years later called praseodymium and neodymium This brilliant work was submitted by Brauner to the Charles University of Prague for his 'habilitation' thesis He was appointed assistant professor there in 1890 and full professor in 1897

During his whole academic career, Prof. Brauner worked intensively at the chemistry of the rare earths and on the determination of atomic weights As a specialist in the first branch, he was asked by Mendeléeff to write the account on rare earths in his famous textbook "Principles of Chemistry", whilst in the other branch he immortalised himself in Abegg's well-known "Handbuch der anorganischen Chemie", to which he contributed his masterly critical discussion on atomic weights. As an authority on those determinations, he fought, together with Venable, for the new base O = 16·000, right down to its general adoption at the Paris Congress in 1900.

Prof. Brauner retired in 1925, after forty-three years of teaching, during which time he lectured to generations of chemists and pharmacists. The highest scientific distinctions came to him not only from his own people, but still more so from abroad. Those he treasured most were the honorary memberships of the Chemical Society of London, the American Chemical Society and the Société Chimique de France, and the honorary D.Sc of the University of Manchester. His seventieth birthday was celebrated by a jubilee number of the *Recueil des Travaux Chimiques des Pays-Bas* in 1925, and his seventy-fifth birthday by the jubilee number of the *Collection of Czechoslovak Chemical Communications* in 1930.

The personality of Prof. Brauner was one of imposing and original individuality His Herculean figure, quick penetrating eyes, high and broad forehead, and strong features harmonised well with his commanding voice, dry remarks and sarcastic wit Yet his sanguine enthusiasm often also brought tears into his eyes, revealing his gentleness of heart and love for mankind and the whole of Nature One of his great hobbies was astronomy, the progress of which he followed as eagerly as that of chemistry. No wonder that with such naturalistic bent he soon became a passionate and ardent reader of NATURE, of which he had read carefully every number, starting from his Manchester days in 1882 Often he contributed to it thoughtful and conscientious reports His recreation was sport, which he introduced and promoted enthusiastically in Bohemia, having become attached to it during his studies in England His Spartan mode of life most probably preserved his health in spite of the noxious atmosphere of the chemical laboratory and his somewhat delicate lungs Yet pneumonia, which attacked him several times in his stronger days, succeeded at last in overcoming him in his eightieth year, to the sincere regret of his two sons and daughter and his many devoted friends and pupils J. H

SIR LESLIE MACKENZIE

WE regret to record the death of Sir William Leslie Mackenzie, which occurred in Edinburgh on February 28

Sir Leslie Mackenzie was a native of Ross-shire and graduated M A , with double honours, at the University of Aberdeen in 1882. He studied medicine in Aberdeen and Edinburgh and, at the latter University, took the degree of M.B , C.M., with honours, in 1888, and M.D , with highest honours, in 1895 He held the D P H and was a fellow of the Royal College of Physicians of Edinburgh In addition to achieving a brilliant career in medicine, Sir Leslie was a recognised authority on psychology and mental philosophy. He had gained the Fullerton and Ferguson scholarships in mental philosophy, and was at one time examiner in mental philosophy as well as in medical jurisprudence and public health at the University of Aberdeen. His later work was recognised in the award of the Medal of Honour of the University of Brussels in 1920. In Aberdeen also he was a resident medical officer in the Royal Infirmary and afterwards was assistant professor of physiology and Arnott lecturer in physiology at Gordons Colleges. In his earlier work he had thus a wide knowledge and interest, as well as considerable and diverse experience.

For Sir Leslie's later work, which was more of a public nature and had its outcome in the development of the various modern branches of public health service during his term of office on the Local Government Board and Scottish Board of Health, he had his first insight while, for a time, assistant to that eminent and widely-known hygienist, Prof. Matthew Hay, medical officer of health for the City of Aberdeen. From this assistantship he became the first medical officer of health for the combined counties of Wigtown and Kirkcudbright, under the Local Government (Scotland) Act, 1889, where he had to organise the public health work of a very large area He and Prof. Hay were selected to give evidence before the Royal Commission (for Scotland) on physical training. He had carried out for the Commission and reported on the examination of six hundred school children, and the Commission's report resulted in the establishment of the School Medical Service.

In 1894, Sir Leslie was appointed medical officer of health for Leith, where his ability and achievements, added to those already accomplished in his previous appointments, led to his selection, in 1901, for the post of medical inspector under the Local Government Board for Scotland. In 1904, he became medical member of the Local Government Board and later of the Scottish Board of Health which took its place In the latter capacities he took a prominent part in the development of the tuberculosis service and the scheme for medical services in the Highlands and Islands of Scotland His name is also closely associated with the development of the maternity and child welfare service, he having, in 1915, prepared a report for the Carnegie Trust on "Scottish Mothers and Children", published in 1917 At this time also he was a member of the Royal Commission on Housing, the Ballantyne Commission, a branch of public health work which he himself regarded as among the most important, if not the most important, of his activities for the betterment of the people of Scotland. He was also crown nominee for Scotland on the General Medical Council.

Among Sir Leslie's published writings, other than those already referred to, were "The Nervous System" in Prof Bain's "Senses and Intellect", "The Development and Outlook of Public Health" in Nelson's Loose Leaf Medicine, "Health and Disease", "The Health of the School Child"; "The Medical Inspection of School Children"

The sympathy of all who knew him, personally or by repute, will go out to Lady Mackenzie, who also is a well known and active social worker. Lady Mackenzie has taken a keen interest and no small part in the effort for the improvement of conditions in Scotland, and is a member of several boards of public bodies and of the Departmental Committee now receiving evidence on the health services of Scotland

News and Views

'Backward Tribes' in the India Bill

COL WEDGWOOD, by moving two amendments on Clause 91 of the India Bill in the House of Commons on March 22, secured from Sir Samuel Hoare a statement of the intentions of the Government in dealing with the primitive tribes of India He pointed out the extreme undesirability of the probable course of action of the Provincial Governments in an effort to assimilate tribal areas to conditions in the rest of the territory under their jurisdiction, and urged the retention of such areas under British control with a system of administration similar to that of 'indirect rule' which has been introduced in West Africa. That the problem is by no means negligible in its dimensions is indicated by the numbers affected Col. Wedgwood's estimate puts the numbers of the backward tribes at 43,000,000, of whom 13,000,000 only will be affected by the protective measures proposed by the Government. These figures are in excess of those given in the Census Report of 1931, where the primitive tribes are stated to number 25,000,000 (in round numbers), of whom 8,280,000 are said to retain their tribal religion. The difference is probably due to the more rigid exclusion in the Census figures of tribes which have passed over recently, or are in process of passing, into the depressed classes, the usual fate of tribes which have come into contact with outside conditions.

ALL observers are agreed as to the delicate equilibrium of the social organisation of the primitive tribes of India, which is unable to withstand even the most impartial application of the principles of British justice In Rajputana, for example, it has been found to have led, in the desire to distribute even-handed treatment, by almost imperceptible degrees to an increase in the power of the land-owner and the restriction of the rights of the tribal holding Any increase in facilities of communication has had a rapidly disintegrating effect. Sir Samuel Hoare was able to give the House an assurance that the Government has this aspect of the matter in view, and he informed the members that, as the result of consultation with expert opinion in India, it had been decided that certain areas, wherever such treatment was possible, would be scheduled for control by the Governor only He closed with the confident statement that "the Government had made the position safe". In so doing, he appeared to rely to a great extent upon the fact that there has developed a school of Indian administrators "who had specially concentrated on the study of the kind of problem that was in the mind of Col Wedgwood" Some assurance, however, that measures are being taken to ensure that the supply of such administrators will not fail in the changed conditions would have been even more welcome.

Antiquities in Iraq

FURTHER details of the allocation of antiquities from Ur as between the Bagdad Museum and the institutions which were responsible for the Joint Expedition are given by Dr. Leonard Woolley in *Antiquity* of March. These, unfortunately, had to be omitted from his communication in *The Times* (see NATURE, 134, 999, 1934); but they should convince any impartial judge of the fairness of Dr. Woolley's contention that the principle of division has operated in favour of the Bagdad Museum, and that there is no ground for the accusation that Iraq has received a negligible proportion of the finds or has been deprived of priceless treasures which should not have left the country Dr. Woolley admits that in the earlier years of the excavations objects of exceptional importance or value were allotted to the share of the Expedition; but this was due to the fact that the Bagdad Museum had not then the technical equipment necessary for their special treatment and preservation. As Dr Woolley's statement is precise, its detail is open to verification; but a reply which has since appeared in the Bagdad paper *el Bilad* evades this issue. Dr. Woolley goes on to show specifically in detail that the Antiquities Department of Iraq, having first choice, was in a position to, and did, select the most valuable and finest specimens for its proportion of the finds, without any compensation being given to the Expedition. The law is interpreted in such a way that there is a danger that the share of any Expedition may become insufficient to justify the expenditure entailed by the work of excavation. The reduction of the number of expeditions in this field to three indicates that this view is only too well founded.

Artificial Lighting at the National Gallery

ON and after April 1 the public will be able to visit the National Gallery, Trafalgar Square, until 8 p.m. on three evenings in the week. This has been made possible by a new lighting scheme, which has been the subject of extensive research during the past six years. The installation has been designed to secure a reasonably high intensity—about 4 foot-candles—upon the pictures themselves, and at the same time to prevent too great a feeling of darkness over the remainder of the room. Suspended fittings, each containing a high powered frosted bulb, are used, and a system of louvers and reflectors directs as much light towards the picture carrying portion of the walls as the architecture of the several rooms will permit. The height of the fittings has been calculated upon the assumption of a viewing distance of eleven feet from the walls. Masks are employed to stop the glare in the direction of doorways: in the majority of cases this has proved satisfactory, though instances will always arise when the geometry cannot be satisfied without producing a shadow on the wall or in a corner. An emergency system of lighting, which comes into operation automatically in case of failure, is held in reserve.

International Vitamin Standards

THE International Standards for vitamins A, B_1, C and D are now available for issue to laboratories, institutions and research workers in Great Britain and Northern Ireland. These standards were accepted for international use at the Second International Conference on Vitamin Standardisation held in London in June 1934 under the auspices of the Permanent Commission on Biological Standardisation of the Health Organisation of the League of Nations. The Conference recommended that they should be kept at the National Institute for Medical Research, Hampstead, N.W.3, which would act for this purpose as the central laboratory on behalf of the Health Organisation of the League of Nations. The standards for the vitamins B_1 and D remain unchanged, and their supply at regular half yearly intervals will be continued as before. The standard for vitamin A has been changed; a pure specimen of β-carotene having been adopted in place of the impure preparation of carotene hitherto employed. The unit of vitamin A remains unchanged, though it is now defined as the vitamin A activity contained in 0·6 microgram of pure β-carotene. In accordance with the recommendations of the Conference, the β-carotene is issued in the form of a solution in oil, of which 1 gm. contains 500 international units. The quantity of this standard solution supplied to each applicant is approximately 5 gm., and, on account of the small quantity available, it can be supplied only at yearly intervals, and not half-yearly as formerly. *l*-Ascorbic acid has been adopted as the international standard for vitamin C, the unit of activity being defined as the vitamin C activity contained in 0·05 mgm. of pure *l*-ascorbic acid. A fuller account of the recommendations of the Conference on Vitamin Standardisation appears elsewhere in this issue (p. 516).

Chemical Engineering in Industry

GREAT BRITAIN is awakening to the importance of the chemical engineer, a man who knows the nature and properties of the new constructional materials or is able to design large plants for the continuous production of those materials which are classed as chemicals. It is at least likely that the big developments in the future will be among the chemical industries making, at a low price, substances for which there is a considerable need, almost automatically as a continuous process. Such will require the ablest chemical engineers to design and operate them. There are two societies active in promoting the subject and in bringing together those who practise it, and post-graduate courses are provided in several of the London colleges. Greater progress in chemical engineering has been made abroad, particularly in the United States and in Germany, and for some time past the desirability of holding an international congress has been realised by those interested, in particular by the late Sir Frederic Nathan. Thanks to the assistance of the World Power Conference with its widespread organisation, a Congress has now been arranged, to take place in London on June 22–27, 1936. The programme, which has just been issued, lists the influential members of the organising committees, whose names are a guarantee of the support the Congress is receiving. It further indicates the scope of the projected programme: this covers plant, fuel and heat and general problems, administration, development and general aspects of the subject. It is desired that the papers, while adhering strictly to chemical engineering, should deal as fully as possible with the economic aspect of the subject. The Committee aims at inviting technicians of repute to present papers dealing with particular aspects of these subjects rather than having a miscellaneous collection of papers, and if they are successful the Congress should be a memorable one.

Dr. William Derham, F.R.S. (1657–1735)

ON April 5, the bicentenary occurs of the death of Dr. William Derham, rector of Upminster, Essex, and for thirty-three years a fellow of the Royal Society. Born at Stoughton, near Worcester, on November 26, 1657, he entered Trinity College, Cambridge, in 1675 and took holy orders. In 1682 he was made vicar of Wargrave, Berkshire, but seven years later was appointed to Upminster, where he spent the remainder of his life and where he is buried Derham united a sincere devotion to his calling with a passion for mathematical and philosophical studies Elected a fellow of the Royal Society in 1702, he contributed papers to the *Philosophical Transactions* on the motion of the pendulum in a vacuum, on sound, sunspots, Jupiter's satellites, the aurora borealis and other subjects His separate writings included his "Physico-theology", 1713; and his "Astro-theology", 1715, while in 1726 he edited "The Philosophical Experiments of Robert Hooke and other Virtuosoes" He was made a canon of Windsor, and in 1730 the University of Oxford conferred upon him the degree of D.D for his services in the cause of religion by his culture of natural philosophy

Lead Mining in the Northern Pennines

THE history of lead mining in the Tyne, Wear and Tees areas during the eighteenth and nineteenth centuries was described by Dr. A Raistrick before the Durham Philosophical Society on March 15. Two companies have worked practically all the mines in these areas, the London Lead Co and the Beaumonts. The former began with a charter granted in 1692 to a company formed in Bristol to attempt the smelting of ore with coal This venture closed after two years, but two Quakers, Edward Wright and John Haddon, of London, obtained the reversion of a much older charter (of 1654) of the Society of Mines Royal (Copper), a German concern formed to work Cumbrian ores Wright seems to have invented the reverberatory furnace, long called the cupola from its shape, and found that it was very suitable for lead refining They extracted silver, and with some Newcastle Quakers founded a smelt mill at Ryton-on-Tyne in 1704, before that (from 1696), difficulties with the oath it contained prevented their taking up the 1692 charter, but these were overcome in 1704, when the accumulated silver was sold to the mint. This company, long known as the "Quaker Lead Company", until 1730 had an output of about 150 oz. of silver a week, and in 1705, Sir Isaac Newton then being Master of the Mint, they were granted a mark which appears on most of Queen Anne's coinage until 1737. The maundy money was coined from their silver for another hundred years They bought ore from Alston Moor, and worked lead also in Flintshire, and finally in Yorkshire, Scotland, Ireland and the Isle of Man. The tale is too long to repeat here, but the Pattinson process of desilverisation was discovered at Blaydon in the Beaumont works. The two concerns worked harmoniously together, and many improvements were made by the London Lead Co. In 1860, the decline set in, the company surrendered all its leases in 1907; and now only three mines are working under the new Weardale Lead Co., and those recently closed will never re-open. An interested visitor at the lecture was the last manager of the old company.

Speed in Aviation

IN his Friday evening discourse delivered at the Royal Institution on Friday, March 22, Prof. B. Melvill Jones discussed the problems of speed. The speed of aerial transport is limited solely by the power which can be provided to drag the aeroplane through the air, without reference to its support; the power required increases very rapidly with speed, but can be much reduced by good stream-lining The recent increases in speed of civil air transport are due mainly to improved stream-lining With well stream-lined aeroplanes the power is expended mainly in overcoming skin friction, so that the detailed study of the skin friction on the curved surfaces of the wings and body merits, and is receiving, great attention by research workers The magnitude of the skin friction force is delicately dependent on surface smoothness and on the smoothness or otherwise of the flow very close to the surface of the wings and body. After perfect stream-lining, in the ordinary sense, has been achieved, still further important increases in speed would follow from any considerable extension of the area over which the flow remains smooth very near to the surfaces of the wings and body, but to obtain this smooth flow over large surfaces moving at high speeds may be very difficult, and it is still a matter for conjecture how much of the great increase of speed which might conceivably be obtained in this way will ever be realised in practice.

Recent Acquisitions of the Natural History Museum

THE Department of Entomology has received from Mr R W Lloyd a gift of drawings of quite exceptional interest and value These consist of the original coloured plates prepared by Jacob Hubner for his "Collection of European Butterflies", published during the years 1796–1830, at Augsburg in Germany. There are 852 plates in all, a number which exceeds that of the published work by many cancelled and amended copies Concerning the identity of some of the smaller insects illustrated there has long been doubt, it is hoped the comparisons which it will now be possible to make between the originals of these figures and the material available in this Department will enable most of these doubts to be removed It is interesting to note that until a few weeks ago it was unknown in Great Britain that these drawings even existed The Department of Geology has recently acquired from Dr. Wyatt Wingrave a large collection of fossil invertebrates (chiefly Ammonites) from the Lias and Inferior Oolite of the Dorset district A crystal of gem olivine (peridot) from Burma has been purchased for the Department of Minerals Presents to the Department include a fine group of large crystals of wolframite from Pelagatos Mountains, Peru, collected by the late Prof J. W Gregory and presented by Mrs. Gregory.

THE Department of Botany has received a collection of dried plants made in Twaong (Tibet) and Bhutan by Messrs G. Sherriff and F. Ludlow There are 523 flowering plants and 53 cryptogams, which are specially dried and preserved, and form a most valuable addition to the herbarium, for few plants have previously been collected from this area. They have not yet been wholly worked over, but it is probable that they contain a percentage of new species which will be of horticultural interest. Seeds of a number of plants likely to prove of horticultural value have been sent and distributed to the more important gardens in the country. The Maharajah of Bhutan kindly granted permission for this expedition to remain longer in the country than originally arranged, and thus enabled collections to be made after the rains were over, which had not been possible in the previous season. Miss Gulielma Lister has presented the 221 original drawings of the "Lister monograph" on Mycetozoa published by the British Museum. The drawings are of considerable artistic beauty and scientific accuracy.

Marine Biology in Ceylon

MR. A. H. MALPAS, acting marine biologist to the Department of Fisheries, in his Administrative Report (Marine Biology) for the year 1933 (Ceylon, Part 4. Education, Science and Art (G), April 1934, Ceylon Government Press, Colombo) expresses his regret at the severe loss the fisheries research in Ceylon has sustained by the departure on leave, preparatory to retirement, of Dr. Joseph Pearson, who has done so much for the fisheries, especially the fish resources of Ceylon. The survey of the pearl banks in 1933 revealed a promising sign of repopulation of the banks, small branches of oysters being found over most of the paar areas, especially over the West Cheval, usually the first paar to receive spatfall after a long period of barrenness. These oysters are not themselves of any fishable value, but are important as they may produce subsequent spatfalls to repopulate the banks. It is anticipated that a considerable area will be covered with spat at the next inspection. Favourable prospects are also shown for a series of fisheries of the window-pane oyster. Experiments were conducted with the view of ascertaining the effects on pearl oysters of abrupt changes of salinity. It was found that oysters kept in a mixture of 1 part of fresh water to 2 parts of sea water were unaffected after several days, while others kept in a mixture of equal parts of fresh-water and sea-water quickly succumbed. Although the experiments are not conclusive they indicate that, as the pearl banks are some miles distant from land, it is not possible for flood-water to bring about such a reduction in salinity as would be harmful to the pearl oysters.

Survey of Salmon and Freshwater Fisheries

PROBLEMS of biological interest are raised in the Ministry of Agriculture and Fisheries Report on the Salmon and Freshwater Fisheries for the year 1933. In at least three rivers, the Wye, the Severn and the Exe, there have been reports that the size and number of smolt shoals migrating seawards in 1933 were well above the average. It is considered that the great majority of these will have arisen from the 1930 spawning, and that year was noteworthy as one in which the number of fish observed on the spawning beds was unusually low. Under such conditions the eggs will have been relatively undisturbed and well distributed. The possibility arises therefore that the presence of too many fish on the spawning beds may be detrimental by causing disturbance of the already spawned eggs and overcrowding of the newly hatched fry. The production of good broods in years when the breeding stock does not appear to be large has also been observed among some sea fish. A further problem of considerable interest is afforded by the occurrence in 1933 of spring-run salmon in the River Plym, where spring fish are not normally found. Their occurrence follows on the introduction of salmon fry from eggs of early running Scottish fish in 1928. If this is an indication that such fish breed true, always producing spring fish, the results of experiments to eradicate the autumn fish running up after the close season will be watched with interest. Although in the year under review there had been a slight decline in the total catch of salmon and migrating trout, the reported mortality of fish as a result of pollution or from furunculosis has fortunately been low in spite of the dry weather conditions. Much work of interest and value is being conducted at the Alresford Experimental Station from the chemical, botanical and zoological points of view, and the usual surveys of a large number of rivers have been made.

Balance of Life in National Parks

THE institution of animal reserves, on a large or small scale, eventually raises a question as to whether artificial control of conditions should be encouraged or abolished. Everyone will agree with the dictum that the object is "to preserve National Park areas in as nearly as possible their natural condition and at the same time to make them accessible to the people for study, for recreation, and for play". Dr. Joseph Grinnell quotes with approval, and suggests (in a short article in the *Journal of the Society for the Preservation of the Empire*, Jan. 1935, p. 61) that animal life in national parks should simply be left alone. "It can be encouraged in amount and variety most practically by desisting from any avoidable interference with the full range of natural conditions of food and shelter. A *do-nothing* policy *is* the soundest policy. . . . Also introduction of non-native kinds of animals should be guarded against like the plague." In general, Dr. Grinnell is correct, but the guardian of reserves, especially of those on a small scale, must be on the alert to correct any tendency to extremes in the population. The reason is that no reserve is a thoroughly 'natural area'; it has somewhere a boundary, and at the boundary natural migrations are checked, and unnatural slaughter takes place which rebounds upon the reserve population.

Quality of Wheat

THE quality of wheat as influenced by environment is the subject of a recent paper by F. T. Shutt and S. N. Hamilton (*Emp. J. Exp. Agric.*, 2, p. 119). The question is not one of scientific interest only, but also of the first commercial importance in the flour-milling and baking industries. Value in wheat depends chiefly on the character and amount of the protein (gluten) it contains, but whereas the former is essentially an inherited factor, the latter may be considerably influenced by environmental conditions. The time which elapses between the formation and ripening of the kernel practically controls its gluten content—the shorter the period the higher the percentage—so that seasonal conditions such as high temperatures and absence of excessive moisture during the later stages of development, which tend to hasten ripening, result in a valuable high-protein wheat. Conversely, a starchy grain is produced if climatic conditions tend to prolong growth during this period. The richness of the soil, even as regards its nitrogen content, does not appear to have much influence on the quantity of protein in the grain, but its moisture absorbing capacity may be of considerable importance as it is necessarily closely associated with the rate of ripening of the crop. From data which have been collected over a period of twenty-eight years at a number of stations in Canada, it has been deduced that the excellent quality of the wheats from the prairie provinces is largely to be attributed to the favourable seasonal conditions that obtain, and not solely to the selection of the most suitable varieties for that district.

Forest Products Research

THE annual report of the Forest Products Research Board with the report of the Director of the Forest Products Research Laboratory, Princes Risborough, for the year 1933 has recently been published (London: H.M. Stationery Office. 1934). In a general statement, the Director notes that the progress of timber research has been satisfactory, whether regarded from the point of view of the actual results achieved or from the value of the results when applied in the timber-using industries and professions. Sir Ralph Pearson retired from the post of director during the year, and Mr. W. A. Robertson, late of the Indian Forest Service, was appointed. The report states that there is evidence of the increasing interest taken by industry in the activities of the Laboratory. The work carried out during the year on seasoning of timber, both kiln and air-seasoning, on steam bending, the structure and mechanical strength of wood and on preservation, is summarised. As a result of investigation work, it is stated that "there is no material difference between old and new timbers from the point of view of shrinkage and expansion", thereby disproving a common belief. Investigations were carried on in connexion with dry rot and insect damage. Tests were also carried out on the cricket bat willow.

Birefringence of 'Viscacelle'

DR. N. H. HARTSHORNE, of University College, Swansea, writes: "With reference to my letter on the birefringence of 'Viscacelle' in the issue of NATURE of February 16 (p. 269), my attention has been directed to a note on the birefringence of 'Cellophane' contributed by Mr. Arthur M. Grundy to *Watson's* *Microscope Record* in 1931 (Sept., p. 22). The name 'Cellophane' is commonly, though mistakenly, used as a general term for artificial cellulose sheet, and as Mr. Grundy did not state the source of his material, I am uncertain as to its exact nature. It was, however, doubtless very similar to, if not identical with 'Viscacelle'. He noted the uniformity of its optical character, and the fact that specimens of different thicknesses gave appropriately different polarisation colours, but he gave no data for the relative retardations associated with different thicknesses. He expressed the view that the optical uniformity of the material ruled out stress as a cause of its double refraction. As regards 'Viscacelle', I do not think that the double refraction is due in any degree to stress in the finished material, but, as I indicated in my letter, the stress involved in the spinning process (that is while the material is being drawn from the spinning slot into the coagulating bath) almost certainly causes an orientation of the cellulose molecules, and this accounts for the observed direction of 'slow' vibration. I regret that I did not see Mr. Grundy's note earlier, and I gladly acknowledge his prior discovery of the double refraction of artificial cellulose sheet."

Native Chinese Drugs of Animal Origin

REMEDIES derived from the animal kingdom bulk large in the old Chinese literature, and three instalments dealing with this Chinese materia medica, compiled by Mr. Bernard E. Read, assisted by Chinese scholars, have been published by the *Peking Natural History Bulletin*. The first instalment, containing the 'animal drugs', and the second the 'avian drugs', were issued some time ago, and now the third dealing with 'dragon and snake drugs' has been published ("Chinese Materia Medica". 7. "Dragon and Snake Drugs". By Bernard E. Read. Pp. 66+6 plates. Peiping: The French Bookstore, 1934. 1.50 dollars.) Besides products derived from snakes, crocodiles, lizards and others, preparations from the fossilised bones of gigantic extinct saurians are included. Attempts are made to identify the creatures mentioned in the old works, and a Chinese index is appended. The whole forms a scholarly work of considerable interest and importance.

British Mosquitoes

A REVISED second edition of the pamphlet entitled "British Mosquitoes and their Control", Economic Series 4A, published by the British Museum (Natural History), has recently appeared. The authors, Messrs. F. W. Edwards and S. P. James, describe the characters and the habits of the twenty-eight species of these insects found in Britain. Measures for the control of mosquitoes and their larvæ are also described, together with means of protection against bites of the insects. The object of the pamphlet is to assist medical officers and others engaged in mosquito control with up-to-date information. It is obtainable, price 4*d*., from the British Museum (Natural History), Cromwell Road, London, S.W.7, or through booksellers.

The Sky in April

THE major planets are moving round towards positions favourable for evening observation. In the middle of the summer we shall see Venus, Mars, Jupiter and Saturn in the evening sky. At present, Venus is very conspicuous in the western sky just after sunset, while Mars becomes conspicuous in the eastern sky a little later. In April, Mars will precede Spica, near which star it has been during March. This planet is in opposition on April 6. Jupiter follows Mars, about two hours behind in right ascension, but its declination is about 17° S. in April. Saturn is still an early morning object. The moon will occult the Pleiades on April 6. The elements of the occultations visible at Greenwich being as follows:

Star	Magnitude	Phenomenon	G.M.T.
η Tauri	3·0	Disappearance at dark limb	$18^h\ 50^m$
η Tauri	3·0	Reappearance at bright limb	19 19
27 Tauri	3·8	Disappearance at dark limb	19 24
28 Tauri	5·2	Disappearance at dark limb	19 37

On the early morning of April 22, the moon will occult Antares, magnitude 1·2. The reappearance of this star at the dark limb will be visible at Greenwich and will take place at $1^h 05^m$ G.M.T.

Announcements

A DISCUSSION on "Gravity Measurements" will be held in the rooms of the Royal Astronomical Society, Burlington House, London, W.1, on April 26 at 4.30. The discussion will be opened by Dr. E. C. Bullard.

THE Triennial Gold Medal of the Royal Asiatic Society has been awarded to Sir Denison Ross, director of the School of Oriental Studies, and professor of Persian in the University of London. The Triennial Gold Medal was founded in 1897 in commemoration of the sixtieth year of Queen Victoria's reign, and is awarded to an Oriental scholar in recognition of outstanding and distinguished services in the field of Oriental research, calculated to further the objects of the Society. The last award was made to Sir Aurel Stein.

THE senate of the Free City of Danzig has decided to found a State Academy of Practical Medicine consisting of eight professors and fifteen honorary lecturers, with Dr. Kluck as director and Prof. Bürgeler as general secretary.

THE third International Congress of Comparative Pathology will be held at Athens on April 15–18, 1936, and will consist of three sections devoted respectively to human and veterinary medicine and the pathology of plant life. Further information can be obtained from Dr. A. Codounis, 40 rue Didotou, Athens.

A CONFERENCE on "Population Studies in Relation to Social Planning" will be held under the auspices of the Population Association of America at the Hotel Willard, Washington, D.C., on May 2–4. The purpose of this conference is to focus attention on the importance of population studies in public affairs, especially in relation to planning Government activities, and to clarify problems on which further research is needed. It will be primarily a conference between research workers in the field of population and persons engaged in administration or teaching in related fields. Further information can be obtained from the Secretary, 308 Victor Building, Washington, D.C.

WE are informed by M. Ch. Marie, general secretary of the International Committee of Annual Tables of Constants, 9 rue de Bagneux, Paris, 6, that the Academy of Sciences of the U.S.S.R. has guaranteed for the next five years a contribution to the international fund for the publication of the Annual Tables. In exchange, the U.S.S.R. Academy of Sciences is to receive a certain number of volumes issued by the Committee of the Annual Tables. These volumes will be distributed among the universities and scientific institutions of the Soviet Union. Similar agreements have been already signed with the French Government, the Swiss Government and the Polish Academy of Sciences.

WE regret to learn that the name of Prof. Ig. Tamm was given incorrectly as "G. Tamm" at the foot of the letter by Mr. J. D. Bernal and Prof. Tamm entitled "Zero Point Energy and Physical Properties of H_2O and D_2O" in NATURE of February 9 (p. 229).

THE January number of *Watson's Microscope Record*, published by W. Watson and Sons Ltd., 313 High Holborn, W.C.1, contains some interesting articles, among them an account of the manufacture of optical glass by Dr. W. N. Wheat, a note on projection with the microscope by W. C. Clothier, and the first part of a description of the theory of the resolution of microscopic objects by E. M. Nelson. These articles will be found of interest by many readers of NATURE, to whom the publication will be sent free on request by Messrs. Watson.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at the City of Leeds Training College—The Director of Education, Education Department, Calverley Street, Leeds (April 10). A physical assistant in the Scientific Department of the Courtauld Institute of Art, 20 Portman Square, W.1—The Registrar (April 12). A City engineer and surveyor for the City of Nottingham—The Town Clerk, Guildhall, Nottingham (April 15). An assistant in psychology at Bedford College, Regent's Park, N.W.1—The Secretary (April 27). A director of the Imperial Forestry Institute, Oxford—The Registrar, University of Oxford.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 511

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Production of Radioactivity by Neutrons

IN a previous letter[1] we described the measurement of the half-lives of a few elements made weakly radioactive by neutron bombardment The same neutron source and method have been used to investigate the radioactivity produced by slow neutrons in metallic zinc, cæsium nitrate, thallium acetate and bismuth carbonate, with the following results

	Half-life
Zinc	100 minutes
Cæsium nitrate	75 minutes
Thallium acetate	97 minutes
Bismuth carbonate	No detectable activity

In addition we obtained the 6-minute half-life for zinc, reported by Fermi and co-workers

The method we have used to calculate these half-lives, and also those published earlier, affords considerable accuracy in the case of relatively long lived elements, even when the activity, measured by counts per minute, is very weak Instead of plotting the rate of counting, dN/dT, as a function of time as is usually done ('differential method'), we have constructed an 'integral' curve (Fig. 1) in the following manner

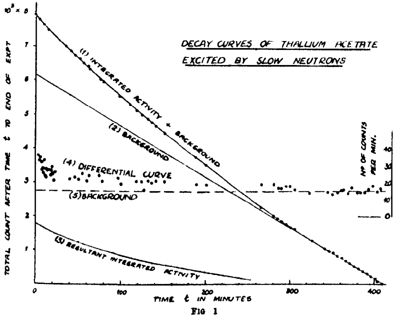

FIG 1

The activity was measured continuously until it had decayed to the normal background of the counter. A curve was then plotted to show the total number of impulses recorded, going backwards in time from the end of the experiment (curve 1). Part of this curve was due to the background, which contributed a total count increasing uniformly in time (curve 2). The difference between these two curves gave the true decay of the active substance (curve 3), it actually represented the number of excited atoms present at any time The points of a logarithmic plot lay very close to a straight line

The superiority of the integral curve method over the differential curve method is apparent from curves 3 and 4 The fluctuations in the counting rate make it exceedingly difficult to draw a smooth differential curve when the activity is weak

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[1] NATURE, 135, 147, Jan 26, 1935

X-Ray Diffraction Patterns of Ice

DURING the last visit of the late Dr. E W Washburn to Toronto in the latter part of 1933, in an address on the properties of heavy water, he announced that water vapour, when condensed at very low temperatures, formed an amorphous rather than a crystalline solid He reported that he did not know of any X-ray evidence to this effect Mr. Fraser Oliver undertook to test this theory by taking X-ray photographs of the ice formed by condensation of water vapour on the outside of a copper rod The copper rod could be maintained at any given temperature The X-ray photographs were taken by the Hull-Debye-Scherrer method

In the accompanying figure [see over] are reproductions of two photographs showing the X-ray diffraction patterns of ice formed at − 85° C (*a*) and − 155° C (*c*) respectively, together with microphotometer tracings (*b* and *d*) of the films In the former case the diffraction pattern consists of lines characteristic of the close-packed hexagonal structure of ice, while in the latter there is one diffuse line corresponding to a spacing of 3·7 A, indicating the amorphous character of the condensate The lines due to diffraction by copper are indicated in both photographs, the other lines being those due to ice.

The results of our experiments, to be published later more fully, indicate that there is a critical temperature about − 110° C below which the condensate is vitreous and above which crystals are formed. Barnes has already established[1] that ice formed by the freezing of water at 0° C exhibits the close-packed hexagonal structure and that no change takes place in the structure of ice between 0° C. and − 183° C.

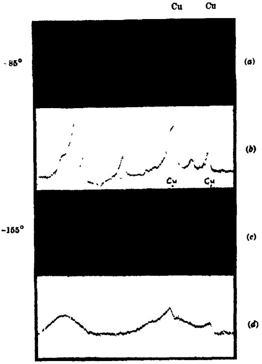

FIG. 1 X-ray diffraction patterns of ice from water vapour condensed at (a) −85° C, (c) −155° C, with corresponding microphotometer curves, (b) and (d)

McLennan Laboratory,
University of Toronto
Feb. 26

E F BURTON
W F OLIVER

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[1] *Proc Roy Soc*, A, 126, 670, 1929

Formation of Galactose in Vital Processes

SOME years ago, Prof Robinson[1] put forward in these columns the ingenious suggestion that the conversion of glucose into galactose in the organism is a direct one and due to an inversion of the configuration of the groups attached to the fourth carbon atom of the glucose molecule, consequent upon esterification of the hydroxyl group concerned by phosphoric acid. It is, however, now recognised that the terminal carbon atoms, as distinct from the fourth carbon atom, are those which are esterified in the fructose di-phosphoric acid involved in biological processes, and that in these latter the acid suffers disruption into the phosphoric esters of *d*-glyceric aldehyde and dihydroxy acetone

In these circumstances it is pertinent to recall first, the demonstration by Schmitz[2] that the α- and β-acroses resulting from Emil Fischer's classical synthesis of hexoses from *dl*-glyceric aldehyde (and dihydroxy acetone) are respectively *dl* fructose and *dl*-sorbose, and secondly, the interconvertibility, shown by De Bruyn and van Ekenstein[3], of *l*-sorbose (which, together with fructose, would result from combination of *d*-glyceric aldehyde with dihydroxy acetone) and *d*-galactose under the influence of alkali.

It may, therefore, be said that in principle a transition from *d*-glucose to *d*-galactose has been experimentally realised, and it may reasonably be asked whether Nature does not avail herself of these reactions for the conversion in question as well as for its direct synthesis in plants of one or both of these carbohydrates Failure to detect trioses in plant products is no more conclusive against this hypothesis than was the difficulty in detecting formaldehyde. Again, whilst it is true that *l*-sorbose has not been found in Nature, *d*-tagatose (which stands in the same relationship to *d*-galactose as fructose does to glucose) also has not been observed, and, on the other hand, *d*-sorbose, but not *l*-galactose, does occur naturally A more serious objection to a biological inter-relationship between *l*-sorbose and *d*-galactose perhaps lies in the fact that the former does not seem hitherto to have been fermented

J KENNER

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[1] NATURE, 120, 44, 1927
[2] *Ber*, 46, 2327, 1913
[3] *Rec trav chim*, 16, 263, 1897, 19, 1, 1900

Molecular Weights of the Phthalocyanines

THE accuracy attainable in determining the molecular weights of organic compounds from the density and cell dimensions of the crystal has recently been the subject of a note in these columns[1]. It is well known, of course, that the crystal data can in general give only a maximum figure for the molecular weight Thus in the relation

$$\text{Molecular weight} = \frac{\text{volume of cell} \times \text{density}}{\text{number of molecules per cell}},$$

a knowledge of the space group enables us to state the maximum degree of symmetry that the individual molecule may contribute to the structure, hence determining the minimum number of molecules in the unit cell and consequently the maximum molecular weight The true molecular weight will usually be a sub-multiple of this figure.

The metallic phthalocyanines[2] appear to offer an almost unique example of a class of compound in which an unequivocal determination of the *true* molecular weight can be made from the crystal data combined with an elementary analysis of the percentage of metal in the compound The results have proved of considerable importance in deciding the structure of these compounds, because their low solubility renders the ordinary methods of molecular weight determination difficult or impossible to apply, except in the case of the magnesium compound[3].

The compounds listed below all belong to the monoclinic system, and the space group C^5_{2h} ($P2_1/a$) is clearly established by the examination of many hundreds of reflections. The maximum symmetry which the molecule can contribute is thus a centre, and if we assume that they display this symmetry, then the number of molecules per unit cell is two, and we obtain the following figures for the *maximum* molecular weight

	Nickel phthalocyanine	Copper phthalocyanine	Platinum phthalocyanine
a	19·9 A	19·6 A.	23·9 A
b	4 71	4 79	3 81
c	14·9	14·6	16·9
β	121·9°	120·6°	129·6°
Mol. per cell	2	2	2
Volume of cell	1186 A.³	1180 A.³	1186 A.³
Density	1 63	1 63	1·98
Max mol. weight	586	583	712

Now the percentage of metal in the compound by elementary analysis gives the minimum possible molecular weight, namely, that of the molecule containing only one atom of the metal. The results are as follows ·

	Nickel phthalocyanine	Copper phthalocyanine	Platinum phthalocyanine
Percentage metal	10 5	11 1	27 1
Minimum mol weight	559	573	720

As the values of the maximum and minimum molecular weights coincide (within the experimental limits), it follows that these figures represent the true molecular weight, and that the formula in each case is $C_{32}H_{16}N_8M$, where M represents the metal atom, which must reside at the centre of symmetry The calculated molecular weights from these formulæ are 571, 576 and 707, for the nickel, copper and platinum compounds respectively. An interesting point is the practical constancy of the molecular volumes. The cell dimensions show that the large flat molecules must be well spread out in the *ac* plane A full discussion of the many remarkable features of these structures, however, cannot be given here.

Nickel and platinum phthalocyanines were prepared by the general methods already described[2] Details will be reported elsewhere All three metallic compounds were obtained in a macro-crystalline form suitable for X-ray examination by vacuum sublimation at temperatures above 500° C The crystal densities were determined by ordinary flotation methods. The improved technique described by Bernal and Crowfoot[1] would doubtless increase the accuracy very considerably.

It is possible that these methods might prove of value in the study of other complex compounds which contain a single atom of some element, provided that the necessary symmetry is displayed by the molecule.

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[1] J D Bernal and D Crowfoot, NATURE, 134, 809, 1934

[2] R P Linstead, *J. Chem Soc*, 1016, 1934

[3] R P Linstead and A R Lowe, *ibid*, 1031, 1934

Absorption Spectra of Substances containing Alkyl Radicals

IN continuation of previous work[1], the ultra-violet (2000–5000 A.) absorption spectra of the vapours of a series of compounds containing alkyl radicals have been measured, using absorbing columns of 5–100 cm and pressures 0·1–15 mm, except with the more volatile compounds, when pressures up to one atmosphere were employed Extensive precautions have been taken to purify the substances studied, previous work having shown that minute traces of impurity may considerably affect the results obtained.

The absorption spectrum of mercury ethyl, $Hg(C_2H_5)_2$, with pressures greater than a few mm is completely continuous at wave-lengths greater than 2380 A. With higher pressures than hitherto used, the long wave limit may lie at greater wave-lengths. With lower pressures a system of diffuse bands is observed, prominent in which are the relatively intense pairs at 2362, 2345, 2305, 2290; 2250, 2235 A. Between these pairs are similar but less intense bands at 2327 and 2272 A A much feebler band occurs at 2390 A and another extremely faint and more doubtful one at 2560 A The bands appear to degrade to the red and in general are broad. The system as a whole has an appearance in general similar to that observed with zinc diethyl, but there are differences. With longer columns there is a much feebler continuous absorption extending from 2420 to 2760 A. with a maximum at 2560 A, the position of the very faint band This continuum appears to be independent of the former The intervals and intensity relationships suggest that a ground state frequency involved is 498 cm^{-1}, modified in the excited state to 305, 294, 279. These frequencies are probably to be associated with valency vibrations of the metal-carbon link, which is excited electronically The other prominent excited state frequency has values 1046, 1060, 1020, and 1075 cm^{-1}, and is probably related to a deformation oscillation in the C–H linkage (1090 cm^{-1}) as found in the case of diethyl zinc and many other examples[2]. If the feeble band at 2560 A is genuine, there would also be a ground state frequency of 3276, which might be connected with a valency vibration in the alkyl group

The above results agree with the previous conclusion with zinc dialkyls that the region of discrete bands is displaced towards longer waves in passing from methyl to ethyl compounds, for Terenin[3] has recently reported a system of bands with mercury dimethyl in the region of 2000 A, with a similar overlapping continuum extending to much higher wave-lengths at the higher pressures

With germanium tetramethyl, absorption is continuous from *c* 2330 A, as found for lead tetramethyl[4]. The continuous absorption previously reported for lead tetraethyl occurs at wave-lengths less than *c* 2350 A. The bands at longer wave-lengths then given for the latter substance have been traced to the presence of a minute amount of benzene, which could not be entirely removed by the vacuum distillation

With triethylamine at pressures up to 20 mm absorption was continuous from *c* 2650 A, but the absorption limit may be at somewhat longer wave-lengths with higher pressures, with triethylphosphine the continuous absorption begins at *c* 2500 A. and there are indications that in both cases at lower pressures with longer columns the continuum may be resolved into extremely narrow diffuse bands. With trimethylamine continuous absorption begins at *c.* 2600 A

With dimethyl and diethyl ether there is a very feeble continuum at wave-lengths less than *c* 2350 A., agreeing with the results of Scheibe and Grieneisen[5] With diethyl sulphide, on the other hand, a well-marked continuum extends from *c.* 2300 A, or with higher pressures from slightly longer wave-lengths. At lower pressures a broad diffuse band appears at *c* 2290 A. Using long columns and very low pressures, when the band at 2290 A. is scarcely visible, there is a faint continuous absorption from a noticeably sharp limit at *c.* 2240 A, and there are indications that the interval 2200–2240 (974 cm^{-1}) is important. It is of significance that a strong Raman frequency of diethyl sulphide is given as 977 cm^{-1} Taken in conjunction with the results obtained for hydrogen sulphide, and ethyl mercaptan C_2H_5SH, it appears that with the diethyl-sulphide the electronic excitation is in the S–C link.

Details of the above work and a discussion of it will shortly be published elsewhere, when the data for other compounds will also be given.

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Jan. 21.

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[2] G. Herzberg and G. Scheibe, *Z Phys Chem*, B, 7, 390, 1930 G. Herzberg and E Teller, *Z Phys Chem*, B, 21, 410, 1933.
[3] *J Chem Phys*, 2, 441, 1934.
[4] A. B F Duncan and J W Murray, *J Chem Phys*, 2, 636, 1934
[5] *Z Phys. Chem.*, B, 25, 52, 1934

Radioactivity of Rubidium

KLEMPERER[1] has recently shown that $_{19}K^{40}$ is very probably the source of the natural β-radioactivity of potassium. This supports the suggestion put forward by the authors[2] based on Fermi's failure to observe induced β-radioactivity when calcium is bombarded with neutrons. Klemperer also suggested that $_{37}Rb^{86}$ is similarly the source of the natural β-radioactivity of rubidium. The effects observed when rubidium, yttrium and strontium are bombarded with neutrons support this suggestion as follows.

Hevesy and Høffer Jensen[3] have shown that $_{19}K^{42}$ formed from scandium has the same period as the radioactive isotope produced when potassium is bombarded with neutrons and it is, therefore, apparent that $_{19}K^{42}$ is formed by $_{19}K^{41}$ capturing a neutron. In a similar manner, the short-lived and weak β-radioactivity induced in rubidium when it is bombarded with neutrons is probably due to $_{37}Rb^{88}$ formed by $_{37}Rb^{87}$ capturing a neutron. If $_{37}Rb^{86}$ is also formed by $_{37}Rb^{85}$ capturing a neutron, then if this nucleus is the source of the natural β-radioactivity of rubidium, so few new nuclei are produced, that the long period will effectively prevent the observation of the corresponding disintegration electrons. It is noteworthy, as Hevesy[3] points out, that the disintegration electrons from the $_{19}K^{40}$ nuclei newly formed when $_{19}K^{39}$ captures a neutron cannot be observed experimentally for the same reason. It is also significant that Fermi and his co-workers[4] have observed no induced β-radioactivity when yttrium and strontium were bombarded with neutrons. Moreover, Szilard and Chalmers[5] have shown that heavy particles are probably ejected from indium ($Z = 49$) and v. Grosse and Agruss[6] have suggested that protons are probably ejected from uranium bombarded by neutrons It seems, therefore, that under the conditions existing in Fermi's experiments, the emission of heavy particles may have followed neutron capture, and that this phenomenon prevails more generally than is to be expected. As, moreover, Chadwick and Feather[7] have shown that the five examples of neutron capture followed by α-particle emission are elements of odd atomic number, it appears that yttrium $_{39}Y^{89}$ is disintegrated under neutron bombardment thus

$$_{39}Y^{89} + n \rightarrow {}_{37}Rb^{86} + \alpha \uparrow .$$

Hence the failure to observe induced β-radioactivity with yttrium may be evidence in favour of Klemperer's suggestion, since the β-rays due to the newly formed $_{37}Rb^{86}$ would be too few to be observed experimentally.

In addition, of eight elements of even atomic number, six emit protons following neutron capture Accordingly when strontium is bombarded with neutrons the action :—

$$_{38}Sr^{86} + n \rightarrow {}_{37}Rb^{86} + p \uparrow$$

may occur and, therefore, the failure to observe disintegration electrons from strontium bombarded with neutrons may be additional evidence in favour of Klemperer's hypothesis

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March 1.

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[5] Szilard and Chalmers, NATURE, 135, 98, Jan 19, 1935
[6] v Gross and Agruss, *Phys Rev*, 46, 241 1934
[7] Chadwick and Feather, International Conference on Physics, 1934

A New Band System of NH

A NEW band has been observed in the spectrum of a hollow cathode discharge through streaming ammonia. The band is degraded to the red and is of simple structure, consisting of single *P*, *Q* and *R* branches Heads are formed at λ4502 and λ4523 by the *R* and *Q* branches respectively.

Preliminary analysis has shown that the upper level of the band is identical with that of the λ3240 band[1] of the $^1\Pi \rightarrow {}^1\Delta$ system of NH The simple structure of the band shows that the transition involved is of the type $^1\Pi \rightarrow {}^1\Sigma$, so that the final level may be identified with the lower $^1\Sigma^+$ level predicted by Mulliken[2] for NH, but previously unobserved Full details will be published shortly

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[1] R W B Pearse, *Proc Roy Soc*, A, 143, 1933
[2] *Rev Mod Phys*, 4, 6 (Fig 37), 1932

Action of Alternating Magnetic Fields upon Ferromagnetic Particles

WILL you allow me to demur to the statement on p. 349 of the issue of NATURE of March 2 that "No satisfactory interpretation of the phenomena was given" of certain experiments of mine on magnetism. The Physical Society invited me in 1928 to give an address on the subject of a 'discourse' which, at the request of the late Sir James Dewar, I had given in 1923 at the Royal Institution. My address at the Physical Society, published in abstract in the *Proceedings* of that Society (vol. 40, part 5, August 15, 1928) ended as follows:

"In his Royal Institution paper the Lecturer gave his reasons for attributing the repulsion to hysteresis. He sees no reason for changing that view In that Paper fuller explanations of some of the effects for which there is not space here are attempted "

Readers of NATURE will, I think, find that the attribution of the effects to hysteristic repulsion was not made by me without very careful consideration.

In his book "The Interaction of Pure Scientific Research and Electrical Engineering Practice" (1927), Sir Ambrose Fleming describes the phenomena and on p 72 remarks

"In the Lecture above mentioned Mr Mordey discussed the various causes to which the above effects may be due, and he came to the conclusion, with which the author of this book agrees, that the effective source of the repulsion is magnetic hysteresis "

The Athenaeum, W M MORDEY
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March 4

THE necessary brevity of the Research Items paragraphs makes it impossible to introduce the reservations and qualifications which would be appropriate in fuller accounts In the item referred to, the purpose was to direct attention to the main points in a paper by H S Hatfield Reference was made to the earlier work of W M Mordey, but full justice could not be done to it To Mr Mordey is due full credit for the discovery of the effects in question, and for his admirable investigations of them His work demonstrated very clearly a dependence on hysteresis This, however, does not enable an immediate explanation of the effects to be given In the last part of his Royal Institution lecture, Mr. Mordey appears to admit that he cannot find a satisfactory explanation of the phenomena, and there seems to be no suggestion of an interpretation on the lines proposed by Hatfield Until Hatfield put forward his convincing and essentially simple explanation of the observed movements of the particles, it seems fair to say that a full explanation of the phenomena had not been given

THE WRITER OF THE NOTE.

Definition and Measurement of General Intelligence

THE fundamental reason why general intelligence cannot be measured exactly by a hierarchical set of tests even if we agree that they define it (unless one of them tests nothing but general intelligence) is that in such a set there is always one more Spearman 'factor' than the number of tests: for each test has its own specific factor, and in addition there is the general factor.

Let z represent a set of k hierarchical test scores, each test standardised to unity, that is, let $z = Ls$, or

$$\begin{bmatrix} z_1 \\ z_2 \\ z_3 \\ \cdot \end{bmatrix} = \begin{bmatrix} l_1 & m_1 & \cdot & \cdot & \cdot \\ l_2 & & m_2 & \cdot & \cdot \\ l_3 & & \cdot & m_3 & \cdot \\ \cdot & \cdot & \cdot & \cdot & \end{bmatrix} \begin{bmatrix} s_0 \\ s_1 \\ s_2 \\ s_3 \\ \cdot \end{bmatrix} \quad (l_i^2 + m_i^2 = 1)$$

where s_0 occurs in every test, the other s's in one each Further, let q be the column vector $\{q_0\ q_1\ q_2\ q_3\ .\ .\ .\}$ where $q_0 = -1$ and $q_i = l_i/m_i$ ($i = 1, 2, 3\ .\ .\ k$) After q_k the q's are entirely at our disposal. q' is the transposed of q, and I the unit matrix. Then the orthogonal matrix

$$B = I - 2qq'/q'q$$

has the property that $L\bar{B} = L$, where $\bar{B}$ is the first $k+1$ rows of B. We can therefore write $s = \bar{B}t$ where it is clear that the 'factors' t are different from the 'factors' s although every test is still 'two-factor' and the correlations are unchanged Thus even if we agree that these tests define general intelligence, we do not know whether it is s_0, or t_0, or u_0, or v_0, or any of the infinite possibilities, all giving different measures for the general intelligence of the whole population. We can rid it of this indeterminateness by adding one or more 'singly-conforming' tests (a better term I think than 'non-conforming' which I used in NATURE of January 12, p 71)

Whether what the tests thus define is general intelligence is a question for the psychologist, not the mathematician

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Biology of Growth and Breeding

THE observations by Cottam[1] on reproduction and growth of the sea-grass, *Zostera marina*, are of considerable biological interest He suggests that perhaps the *length* of the growing season may be an important factor in determining the breadth of the leaves in any habitat, and points out that Setchell has shown that reproduction in the species occurs between 15° and 20° C and growth in the range 10°–20° C. In recent work on increase in shell-area in the oyster[2], I found that there is large spring as well as autumn growth in the Fal Estuary, but only a trace of growth in spring, with a large summer or autumn growth in the River Blackwater Now in the Fal Estuary the temperature rises slowly from about 10° in winter, whereas in the more insular Blackwater oyster beds the rise is very rapid. Breeding begins in the oyster[3] at about 15°–16° C, and increase in shell-area ceases at the onset of the breeding season There is thus a longer spring growing period in such hydrographical situations as the Fal Estuary than in localities like the Blackwater.

The parallel of growth and breeding in the oyster with *Zostera marina* is striking, as also is the convergence in their biology It is well known that many animals breed at a relatively small size under relatively high temperatures[3], and the explanation offered[3] is that there are, in many non-stenothermic animals, growth and breeding metabolisms governed by different temperature ranges, which give rise to a physiological antagonism between breeding and growth It may therefore be deduced that when such an organism has attained a *certain level of maturity*, it will begin to breed providing temperature and other conditions are suitable This level of maturity may occur at a small size, and if breeding conditions do not then obtain, growth may continue and produce a larger or different facies of organism before breeding occurs. There are winter as well as summer breeders, and the habitat and rhythms of the whole life cycle need to be studied in each species for a full understanding of the biology The observations made in the study of the habitat of the oyster and the cockle[4], it is interesting to note, may be of value in leading to an understanding of the broad-leaved *Zostera* found in deeper water off the coast of Great Britain.

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Feb 22.

[1] Cottam C, NATURE, **135**, 306, Feb 23, 1935

[2] Orton, J H, *J Mar Biol Assoc.*, **15**, 384, 419, 1928.

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Experimental Induction of Coupling in *Xenopus laevis*, with the Production of Fertilised Eggs

IN the course of an investigation into the sexual cycle of *Xenopus laevis*, the South African clawed toad (Shapiro and Zwarenstein[1], Shapiro and Shapiro[2]), certain outstanding differences in the sexual behaviour of this amphibian were observed under laboratory conditions as compared with natural conditions prevailing in the pond It was noticed, among other things, that mating activity was never in any circumstances exhibited in captivity in the laboratory even at the height of the breeding season (July to September in South Africa)

In order to investigate the factors concerned with the mating reflex, toads fresh from the pond were brought into the laboratory at monthly intervals from August 1934 These toads were divided into three groups with appropriate controls (Details of these experiments will be given in a forthcoming publication)

In the first group, both the male and the female toads were injected with an acid extract of sheep's anterior pituitary, with an extract of pregnancy urine (prepared according to the method of Katzman and Doisy[3]) and a similarly prepared extract of male urine In the second group, females only and not males were injected with these extracts In the third group, males only and not females were injected similarly

The results were as follows –

A maximum percentage of coupling took place when both males and females were injected with either pregnancy urine or anterior pituitary extract

A smaller percentage of coupling occurred when females only and not males were injected This percentage rapidly dwindled to zero, the further from the breeding season in point of time the injections were made

No coupling was observed when males only and not females were injected, even at the height of the breeding season

In no case did the male urine extract induce the act of coupling or ovulation.

Colour change in *Xenopus* (which involves a pituitary mechanism, Hogben and Slome[4]) did not affect the mating reflex

Several pairs of coupling toads were killed at the beginning of the act of mating and their oviducts were found to be entirely free of ova. Ovulation has also been observed without concomitant coupling.

In all, the mating reflex has been induced experimentally in 71 different pairs of toads with pregnancy urine extract and in 20 different pairs with anterior pituitary extract The act of coupling lasts 24–48 hours, and fertilised ova were recovered from the containers of such coupling pairs The ova were successfully reared for 4-5 months to the tadpole stage.

By injection of the above extracts coupling can be induced in the laboratory not only near the breeding season, but also in midsummer, that is, the midpoint between two breeding seasons In all cases tadpoles have so far been reared successfully from such fertilised eggs.

The experiments also suggest:

(1) That a female stimulus initiates the response by activating the male.

(2) That the anterior pituitary is involved in this complex pattern of motor behaviour

(3) That the pituitary mechanism associated with colour change in *Xenopus laevis* is not concerned with the mating reflex

(4) That if the same chemical substance initiates ovulation as well as coupling, it initiates these two activities at different thresholds

A further investigation into the details of the mating reflex is being carried out

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Jan 31.

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[1] Shapiro and Zwarenstein, *J Exp Biol*, **10**, 4, 372 1933
[2] Shapiro and Shapiro, *J Exp Biol*, **11**, 1, 73, 1934
[3] Katzman and Doisy, *J Biol Chem*, 744, 1932
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Use of Cellulose Films in Palæontology

REFERENCE has been made by S Leclerq[1] and J E Appel[2] to the use of cellulose films or 'peels' in palæontology, but there does not seem to be any published account of the procedure involved In the method outlined below, which was suggested to me by Prof L J Wills, and used in the first place to record the internal structure of rugose corals, a cellulose cast is made from an etched surface, and structural detail stands out solely by reason of the optical effect of textural variation

The cellulose solution is most easily prepared by diluting the commercial preparation 'Durofix' with about twice its volume of butyl acetate, I have also found very satisfactory the solution advocated by R Graham[3]

The cut surface of the coral is ground with fine carborundum, etched for five to ten seconds with dilute (10 per cent) hydrochloric acid, washed and allowed to dry, the finer the organic structure, the shorter is the time of etching required. The specimen is mounted on plasticine so that the etched surface is horizontal, and after moistening the latter with butyl acetate as a precaution against air bubbles, the cellulose solution is poured on to form a layer about 2 mm thick The solution dries in 3–5 hours, and the edge of the film is then lifted from the specimen with a sharp blade, and the whole film peeled off The film can conveniently be preserved between glass plates bound together at the edges.

The method is applicable to any fossil in which a difference in relief and texture between the organic parts and the surrounding matrix can be obtained by etching with hydrochloric or hydrofluoric acid. In the preparation of serial records it is advisable to embed the specimen in plaster of Paris before grinding; the distance between successive peels can be measured with a spherometer Peels from corals and brachiopods show not only the outlines of the skeletal elements, but also the detailed fibrous or lamellar structure of these; some which were prepared in 1931 are still free from contraction or discoloration.

An important possibility is the distribution of duplicate records of type specimens, since a great many peels can be made from a prepared surface without re-grinding or re-etching

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Feb. 28

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[1] *Annales de la Soc. Géol. Belg*, **52**, B24–27, 1928.
[2] *Econ. Geol*, 353–358; 1933.
[3] "Stain Technology", 1928, vol 3, *pp.* 65–68.

A Remarkable Whirlwind

'DUST DEVILS', or rotating columns of sand travelling rapidly across open spaces, are not uncommon objects to desert travellers. Their height and breadth is often very considerable and the violence of the eddies causing them very great.

The smallest of this type I have seen was only about 5 ft. high, that is, the visible column of sand, and less than a foot in diameter. It passed so close to me that it was easy to see its narrow cycloidal path marked on the sand, which was deposited and lifted as the eddy travelled on at not less than 15 miles an hour, although the wind was actually very light.

I recently encountered a much more remarkable example while walking over a smooth surface of desert on a flat calm day. Hearing a swishing sound behind me, I turned and observed a large revolving ring of sand less than a foot high approaching me slowly. It stopped a few feet away and the ring, containing sand and small pieces of vegetable debris in a sheet less than one inch thick, revolved rapidly round a circle of about 12 ft. diameter while the axis remained stationary. It then moved slowly round me after remaining in one spot for at least thirty seconds, and slowly died down. It would be interesting to know if others acquainted with the desert have come across similar examples of a broad, flat eddy.

The ancient superstition among desert tribes that these whirlwinds are spirits, called 'afrit' or 'ginni' (the 'genii' of the "Arabian Nights"), would seem to have a reasonable foundation in face of such an 'inquisitive' apparition.

Cairo. J. L. CAPES.

Thermal Decomposition of Acetaldehyde

IN a letter in NATURE of January 12, Mr. Hinshelwood stated that further work in his laboratory by Dr. Winckler on the thermal decomposition of acetaldehyde had refuted the criticism of his work contained in a communication to the Royal Society of May 10, and in letters in NATURE of October 13 and 27, 1934. The results of this work appear in a paper which he communicated to the Royal Society at a meeting held on March 7, at which it was read in title only. The results are held to yield no evidence that the reaction represented by the equation, $CH_3CHO = CO + CH_4$, is appreciably heterogeneous, or that it depends upon a chain mechanism.

Mr. R. V. Seddon and I have also been engaged in a research on the same subject, with results which appear to us to point in exactly the opposite direction. The work is not completed, and the results may not be published for some time, so we ask permission to point out that the last word has not been said upon this subject.

M. W. TRAVERS.

Points from Foregoing Letters

THE half-life period of radioelements formed when metallic zinc, cæsium nitrate, thallium acetate and bismuth carbonate are submitted to bombardment by slow neutrons is given by Prof. J. C. McLennan, Mr. L. G. Grimmett and Mr. J. Read. The authors also describe a way of plotting the observed activity, which allows of a more exact determination of the life period of relatively long lived radioelements.

Prof. E. F. Burton and Mr. W. F. Oliver submit photographs of X-ray diffraction patterns indicating that at very low temperatures (below −110° C.) water vapour solidifies in amorphous form, while above that temperature it forms crystalline ice.

Galactose, a constituent of the milk sugar molecule, is apparently formed in the animal body from glucose, which has the same chemical composition, but different structure. Prof. Robinson has suggested that the change from glucose to galactose occurs through a relatively simple rearrangement of the atoms (brought about by phosphoric acid). Prof. J. Kenner now suggests that the glucose molecule is first broken up and then recombined to form galactose.

Molecular weights were first determined from combining ratios, osmotic and gas pressure, etc. Recent physical methods (for example, ultracentrifuging) sometimes give results differing from those obtained by the original methods. A way of obtaining the maximum molecular weight from density and X-ray crystallographic data is described by Dr. J. Monteath Robertson, Dr. R. P. Linstead and Mr. C. E. Dent. They show that, in the case of metallic compounds of phthalocyanines, it gives values agreeing with those obtained by the combining ratio method.

Prof. F. H. Newman and H. J. Walke adduce reasons supporting Klemperer's view that the natural radioactivity (emission of electrons) of rubidium is due to the presence of an isotope of mass 86.

From the fact that independent intelligence test scores fit 'tetrad' formulæ which equate to zero, Spearman has deduced that a general intelligence factor *g* must exist in addition to special abilities. Prof. G. H. Thomson explains that though such hierarchical tetrad sets may prove the existence of *g*, they cannot in general measure it unless one of the tests measures general intelligence alone, or unless a 'singly-conforming' test is added.

In the case of animals which can live under various temperature conditions (non-stenothermic) there may be temperatures which are favourable for growth and not for breeding. Prof. J. H. Orton finds that the oysters in the Fal Estuary show a larger spring growth than those in the River Blackwater; he ascribes this to the fact that the temperature in the Fal Estuary remains longer in the spring between 10° and 15° C. (which promotes growth), while that of the River Blackwater rises more quickly to 15° to 20° C. (which facilitates reproduction).

Dr. H. A. Shapiro has investigated the effect of extracts of the anterior pituitary, of pregnancy urine, and of male urine, upon the mating instinct of the South African clawed toad. He finds that coupling is induced by the first two extracts. He deduces, among other things, that the anterior pituitary is involved in the mating reflex and that a female stimulus initiates the response in the male.

Mr. A. J. Butler describes the technique of preparing cellulose film casts from the etched surface of corals and other fossils. Such casts show structural details and have the advantage that a number of identical reproductions can be readily obtained to serve as type specimens.

Research Items

An Orissa Cult. Research in India during the last half century has brought to light the unexpected existence of a number of obscure cults, such as the masked Buddhism of Bengal, fire-worship in a remote corner of Rajputana, and curious agricultural cults in Bihar. Such survivals are compared by Sarat Chandra Mitra in a recent communication (*J. and Proc. Asiat. Soc. Bengal*, New Series, **30**, No. 1) to a cult of a horse-headed goddess, of which evidence has been discovered in Orissa. Prof. Priya Ranjan Sen has found the "mare-headed Bāsulī" worshipped in various localities in Orissa by Keots and allied castes. The cult has a sacred book, said to have been written in Uriya by Achyutā Dās, one of the five companions of the great Vaishnava reformer Chaitanya Deva. He thinks that Bāsulī was originally a Dravidian deity, who was gradually transferred to the Hindu Pantheon. Her deityship is represented by an image with a horse's head and sometimes by a horse wholly made of wood. From a recently discovered folk-ballad, the development of the cult can be traced to a horse which was born from the water to help, and then serve as the mount of, a Dāsa king. It is hence inferred that the horse is the totem of the Keots and allied castes of Orissa, for the horse in the ballad is evidently a spiritual being connected in some way with the origin of the Keots—possibly their ancestor to whom they paid homage in the form of a wooden image, afterwards transformed into a goddess with a horse's head. The Khangars of Bundelkhand have a horse for their totem, but do not worship it. Reference is also made to the peacock totem cult of the Mori sept of the Bhils, and the tiger and hyæna totems of the Orāons, the Kurmi sept of the Mahilis of the Santal Parganas and the Jagganāthi Kumhārs of Orissa. If this contention can be maintained, it provokes dissent from the opinion of Risley that "the religious side [of the system of totemism] has fallen into disuse" in India.

Early Pottery in Beth Shan. In 1933 the expedition to Beth Shan of the University Museum, Pennsylvania, then in the tenth year of its work, carried its excavations down to virgin soil within a restricted area with the view of discovering the depth and nature of the levels which underlay the Middle Bronze Age stratum of about 1700 B.C. at a depth of thirteen metres (43 ft.) then being explored. A stratified succession of eight occupation levels was discovered, through a depth of 8.50 m. below the level previously reached, which goes back to an occupation of pit-dwellings in virgin soil earlier than anything previously found in Palestine. The pottery from these eight levels, which cover twelve separate periods of rebuilding, has been described and figured by Mr. G. M. Fitzgerald (*Museum J.* (Philadelphia), **24**, No. 1). For convenience of description the pottery is classified into a threefold division: Levels xviii-xvi, xv-xiii, and xii-xi, which represent conspicuous changes in the character of the pottery, but cannot be assumed to indicate any change or interruption in occupation until the end of the Early Bronze Age. There are no sterile layers or burnt strata between any of the levels. The ware of the pit-dwellings is poorly burnt and gritty, hand-made, and often showing signs of a red slip or wash. In levels xii-xi the dominating characteristic is an abundance of lustrous burnished pottery which is unlike anything in the levels below. This is the Kherbet Karan ware, so called from the site on the lower side of the Sea of Galilee where it was first found. It may be regarded on one view as here marking the first period of the Middle Bronze Age.

Dynamics of Animal Populations. Several mathematicians have recently been trying to codify into a harmonious system of formulæ the facts about increase and periodic fluctuations in animal populations. A. J. Lotka, a pioneer worker in this field before the War, has published the first part of a monograph on the subject ("Theorie analytiques des associations biologiques", Actualités scientifiques et industrielles, 187. Exposés de biométrie et de statistique biologique No. 4. Part 1. Principles. Pp. 45. Paris: Hermann et Cie, 1934). Changes in numbers in an animal community are really the redistribution of available matter and energy, through the selecting and concentrating powers of various living organisms, and as such can be studied by some of the mathematical equations employed for defining physico-chemical reactions. Equations expressing the interaction of two species are discussed, with special reference to the rates of increase, as a preliminary to the consideration of more complicated cases.

Historical Review of the Woodcock. The January number of the *Canadian Field Naturalist* is given over to a historical review by Henry Mousley of the knowledge of the habits and anatomy of the woodcock, compiled from the earliest drawings and accounts to those of the present day. Both the European and American species (*Scolopax rusticola* and *Philohela minor*) are included in the review, and the author has been fortunate in having at hand the 5,000 original drawings and paintings of birds and other animate things in the Blacher and Emma Shearer Wood Libraries of McGill University. For example, a drawing of about 1805 showed that the flexibility of the upper mandible of the woodcock's bill was known to the artist, although the discovery has been attributed to Turnbull so late as 1890; the only reference to the character, earlier than the drawing mentioned, is by Naumann in 1799. The story of the discovery of the unusual position of the ear and vertebral column relative to the skull as a whole is traced, as well as other points of interest.

Life-History of *Philine*. Mr. Herbert H. Brown has made a detailed study of the tectibranch *Philine aperta* (*Trans. Roy. Soc. Edinburgh*, **58**, Part 1, No. 9, 1934). This mollusc is common in the estuaries and creeks of the British coasts, burrowing in the sandy mud, especially above low-water mark, and is often associated with *Zostera*. In Loch Sween, where the author collected his material for the present research, it is one of the victims of the recent *Zostera* disease, its numbers being much reduced in places. Part 1 deals with the anatomy of *Philine*, Part 2 with its development. The eggs are laid in gelatinous strings by which the mass is firmly moored in the mud or sand. The newly hatched veliger has a simple shell and small bilobed velum. A conspicuous feature of the animal is a round black mass on the right side in the body wall This is the so called 'secondary kidney', which does not itself give rise to the true kidney, the latter replacing it in due course The larva grows quickly and gradually metamorphoses into the adult After the velum is lost, the young animal may still be found in the plankton but soon finds its way to the bottom The paper is well illustrated with text figures of the anatomy of both adult and larva

Sandflies and Kala Azar. In their further investigations on Mediterranean kala azar, S Adler and O Theodor (*Proc Roy Soc Lond*, B, 801, Feb 1935) have found that infections of the proboscis are rare in sandflies infected with the Maltese and the Catania strains of *Leishmania infantum*, and that the majority of such infections of the proboscis occur towards the end of the sandfly season. They also found that only those sandflies (*Phlebotomus*) which have the flagellate stage of *Leishmania* in the distal part of the proboscis are capable of depositing the flagellates in the skin during the act of piercing The flagellates are passively deposited during the movements of the epipharynx in the tissue It is inferred that the majority of infections in human beings are acquired towards the end of the sandfly season, and this view is supported by the fact that half of all the cases in Catania are diagnosed from the end of April to the middle of May, that is, from six to eight months after the end of the sandfly season. They consider it is highly probable that there are distinct strains within all the recognised species of human *Leishmania* In the area in which the investigations have been carried out, dogs form reservoirs from which sandflies obtain *Leishmania*, the number of sandflies which infect themselves on human cases is comparatively small

Finger-and-Toe Disease of the Cabbage Family. Dr. G. Potts has recently published a paper giving a large amount of information about the incidence and control of finger-and-toe disease of cruciferous plants (*Trans. Brit Mycol Soc*, 19, No 2, Jan 1935) The experiments were performed before 1905, and it is rather a reflection on the slow progress of knowledge about this disease, that the paper is still of great interest and significance Severity of attack by the fungus varies with the host, and symptoms for a considerable number of plants are given. Many experiments were directed to a study of the effect of soil reaction on the virulence of the pathogen The application of sodium carbonate to the soil invariably controlled the disease more thoroughly than lime, though *Plasmodiophora* was found to occur and produce the characteristic swellings in highly calcareous soil, and in soil devoid of organic matter. Several questions as to infection by spores were also investigated, and the account has been brought up to date and correlated with more modern work on the same subject

Mycorrhiza in Relation to Forestry. There is general agreement that healthy growth of pine and other conifer seedlings is always accompanied by free development of fungus-roots, and that poor growth and lack of vigour are associated with defective mycorrhiza formation No satisfactory evidence has hitherto been offered that the two phenomena are causally related, but M. C Rayner (*Forestry*, 8, No. 2, 1934) now describes field experiments and laboratory cultures with various species of *Pinus* which prove that the presence of mycorrhizas normal for the species is causally related with proper nutrition and healthy growth of the seedlings In cases where mycorrhiza development was defective, the condition was relieved and growth of the seedlings stimulated by inoculating seed-beds with small amounts of humus containing active mycorrhizas of the species. But the beneficial effects following inoculation are controlled by factors operating within narrow limits, since they are readily influenced by variation in experimental treatment, as, for example, the date of sowing Hence it is important that a suitable technique for promoting mycorrhiza formation by means of humus treatments should be carefully worked out and standardised. Evidence was obtained of close correlation between particular soil conditions and the behaviour of specific mycorrhiza-formers, disturbances leading to replacement of mycorrhizas by parasitic pseudo-mycorrhizas with consequences adverse to the health and vigour of the hosts On the heath soils used in the field experiments, it was found that mycorrhiza deficiency was due to inhibiting soil conditions rather than absence of appropriate mycorrhiza-formers, and the inhibiting action was reversed by the addition of organic composts to the seed-beds, resulting in mycorrhiza development, accompanied by increases in root and shoot growth which could not be attributed to direct manurial action

Hydrology of Asia. Accompanying a paper on "Die Gewässer Eurasiens", Dr F Jaeger has produced in *Petermanns Mitteilungen* of January 1935 a novel map of the water features of Europe and Asia In addition to the topographical features in which water plays a part, there are differentiated the wet and the dry climates, the limits of frozen soil, the occurrence of ice dams on the rivers, the limits of snowfall and the occurrence of glaciers A further useful feature of the map is the distribution of the main types of surface apart from vegetation, such as sand, swamp, karst, etc The map is on too small a scale (1 30,000,000) to show any country in detail, but is useful in illustrating broad contrasts

Scottish River Gauging. We have received from River Flow Records, Parliament Mansions, S W.1, a further memorandum (No 2) on the subject of river flow measurement on the Aberdeenshire Dee, which was originally noticed in NATURE of September 8, 1934, p 352 The development of the records is shown by three documents, the first exhibiting a standard form for water level records intended to be completed at the Water Engineer's Office, Aberdeen; the second a stage-flow table compiled from river gaugings taken, mainly, between mid-September and mid-November 1934, with two types of apparatus—in all, about 7,000 velocity observations were made, including continuous night and day work during three high floods, the third document is a quarterly records diagram, exemplified by readings from the River Garry, at Invergarry, the diagram being designed to present the complete data of records relating to water levels, aggregate rainfall and run-off in a form suitable for publication It is anticipated that the record diagrams for the River Dee for the whole year 1934 will be completed in a few weeks time and that, thereafter, other water recorders will be established at Balmoral and Dinnett, with a view to the completion of the flow gauging, the records being kept at an office in Aberdeen.

The Claude Power Scheme. The December 1934 issue of the *Annals of the Brazilian Academy of Sciences* contains an address by Georges Claude, of the Paris Academy of Sciences, on the present state of his work on the use of the sea as a source of power. His proposal is to evaporate surface water by reducing the pressure on it to about 1/100 atmosphere and condense it by means of water at a lower temperature brought up from a depth of 600–700 metres. His attempt to carry out this project on the coast of Cuba failed owing to the destruction of the cold water tube 2 kilometres long by a storm. His present attempt is being made at sea 70 miles south of the Bay of Rio de Janeiro on board the S.S. *Tunisie*. The cold water tube is here vertical, and of sheet iron insulated by wood; it is 650 metres long and 2·5 metres in diameter. The surface water has an average temperature of 24·5° and the lower water 6·5° C. The tube is supported by a float independent of the ship, a flexible tube connecting the two. The vapour produced by the evaporation of water taken from the surface passes through turbines to the condensers, and the power available is estimated at 1,300 kilowatts, but the figures on which this is based are not given, nor are the heats of evaporation and condensation mentioned.

Combustion and Explosion. The *Zeitschrift für Elektrochemie* of March 1935 contains a review by Dr. W. Jost of the "Mechanism of Explosions and Combustions". Chain mechanisms, which are now so much in the limelight, do not occupy much space in this review, although Semenoff's work is frequently referred to, but ample references are made to the experiments of Bone, Finch, Wheeler and Coward, in Great Britain, and of Bernard Lewis in America, as well as to Haber's experiments in Germany. Two tables of observed and calculated velocities of detonation are cited from Lewis's work, and the literature references number exactly one hundred. The wide scope and unbiased character of the discussion make this review of real value as a summary of the present position of this important subject.

Early Stages of the Electric Spark. U. Nakaya and F. Yamasaki have studied the formation of ions in a spark gap by putting the gap in a Wilson cloud chamber (*Proc. Roy. Soc.*, A, Feb. 1). Immediately after the expansion, the potential was applied to the gap for a short time by means of an impulse generator, and a photograph was taken a few hundredths of a second later. Distortion of the ion distribution by electric winds was avoided by the short time of application of the potential. The potential was usually insufficient to produce a fully developed spark, but violet brushes could be seen in some of the experiments. At low voltage a spindle-shaped ion cloud appears at a point on the negative electrode; at a higher voltage a bundle of streamers appears in addition on the positive electrode. These grow longer and take a branched form when the potential is further increased. These figures have a resemblance to the positive Lichtenberg figures obtained on a photographic plate.

A Spectroscopic Determination of e/m. Work carried out before 1929 did not give good agreement between the values of e/m obtained for free electrons and those obtained spectroscopically. This discrepancy has tended to disappear in more recent work. C. D. Shane and F. H. Spedding (*Phys. Rev.*, Jan. 1) have made a precise spectroscopic determination by measuring accurately the frequency difference between corresponding parts of the line structure of $H^1\alpha$ and the heavy hydrogen line $H^2\alpha$. The method gives directly the ratio of the mass of the electron to that of the hydrogen nucleus, and e/m may then be calculated when we know the Faraday electrolytic constant. A liquid-air cooled discharge tube was used as light source, and a Fabry Perot étalon combined with a large grating was employed to resolve the lines. The separation was found by analysis of microphotometer curves. The final value is $e/m = 1·7579 \pm 0·0003 \times 10^7$, which agrees with other recent results by the two methods.

Empirical Heat Capacity Equation. The classical form of equation relating heat capacity to temperature: $C_p = a + bT + cT^2 + dT^3 + \ldots$, is known to fail in certain cases, and it is proposed that it should be replaced by an equation of the type $C_p = a + bT + cT^n$. The success of this equation depends upon the value of n employed, and it is desirable that a single value of n should be selected which gives satisfactory values for a wide range of substances, and it is also essential that the equation shall be readily integrable for the purpose of arriving at values for the energy. J. Chipman and M. G. Fontana (*J. Amer. Chem. Soc.*, **57**, 48; 1935) propose the equation in which $n = -\frac{1}{2}$, and show that for several typical substances, including gases, magnesia, graphite and calcium silicate, the equation gives results which are sufficiently accurate for thermodynamic calculations, the temperatures in all cases extending to above 1,000° C. The data for the solids used are experimental; those for the gases are theoretical values calculated from spectra. An equation of the first—power series—type, proposed by Eastman, and one proposed by Kelly, were found to be not at all trustworthy when extrapolated beyond the range for which each was intended.

The Lead Accumulator. In three recent papers (*J. Amer. Chem. Soc.*, **57**, 9, 27, 33; 1935), H. S. Harned and W. J. Hamer have reported experimental work and calculations which have an important bearing on the thermodynamic theory of the lead accumulator. They conclude that the reversible cell reaction is that proposed by Gladstone and Tribe:

$$PbO_2 + Pb + 2H_2SO_4 = 2PbSO_4 + 2H_2O$$

The experimental work involved the measurements of the electromotive forces of various types of cells at different acid concentrations and temperatures. In the calculations, the activities of water in sulphuric acid solutions, the activity coefficients of sulphuric acid in aqueous solutions of concentrations 0–17·5 *M* and at temperatures from 0 to 60°, and also thermal data are involved. The results are compared with measurements of vapour pressures, freezing points and heats of dilution, and very satisfactory agreement is found. A number of interpolation equations have been worked out and a very comprehensive study of the electrode potentials and reversible electromotive forces of cells related to the lead accumulator is presented in a condensed and convenient form. One of the matters investigated was the preparation of lead dioxide by different methods, the specimen prepared by electrolysis of a solution of lead nitrate and nitric acid giving the most consistent results.

Atmospheric Electricity in Australia

THE work initiated by the late Prof. W. G. Duffield on the foundation of the Solar Physics Observatory at Canberra included preparations for the study of atmospheric electricity. This work is now yielding results; a few months ago Mr. A. R. Hogg published an analysis of observations of conductivity and of the nucleus-content of the air, and now a memoir on potential gradient prepared by Mr. C. W. Allen has been printed in the series of official publications of the Commonwealth Observatory*.

Potential gradient has been recorded at various places with more or less precision for the best part of a century, but it is only within the last few years that clear ideas as to the significance of the measurements have been developed. Mr. Allen has been able to incorporate some of the new ideas in his discussion of the records obtained at the Commonwealth Observatory, and there are many points of interest in his memoir.

The Observatory is on Mount Stromlo, a flat-topped hill 780 m. above sea-level, 200 m. above the surrounding country, which is 12 km. west of Canberra and 120 km. from the sea-coast. The only sources of pollution in the atmosphere are the occasional bush fires. It is not likely that these have affected seriously the results which Mr. Allen sets out in his memoir, which deals in the main with the potential gradient in fine weather.

It is well known that the upper atmosphere is at a high positive potential compared with the ground. For this purpose we may regard the upper atmosphere as being either the Heaviside layer or the atmosphere at a height of 10 km. or so. Under the influence of this high potential, a current, the air earth current, flows down to the ground. The strength of this current varies inversely with the resistance of the air column. The potential at a height of say one metre above the ground is proportional to the current and to the resistance of the air in this lowest metre. The potential gradient may also be regarded as a measure of the negative surface charge on the ground or of the complementary positive charge distributed through the atmosphere. For the interpretation of observations of potential gradient all these factors must be borne in mind.

Mr. Allen has looked for the influence, at Canberra, of the world-wide changes in the potential of the upper atmosphere, by studying the changes of potential gradient on days with continuous strong wind, realising that on such days the changes of conductivity of the lower atmosphere will be comparatively small. He finds that under these conditions the diurnal variation of potential gradient approximates to the type found over the oceans, a type in which the maximum gradient occurs at about 19 h. G.M.T., the minimum at about 3 h. G.M.T. According to Wilson the potential of the upper atmosphere is maintained by thunderstorms and, as was first pointed out by Appleton, the diurnal variation is due to the fact that the activity of thunderstorms is at its maximum when it is afternoon in one of the tropical continental areas and at a minimum when it is afternoon over the Pacific. When the distribution of thunderstorms is studied in detail, it is found that the regions of activity are farther west in the northern summer than in the northern winter, so that the maximum activity occurs later in the Greenwich day in the former season. The corresponding delay in the occurrence of the maximum potential gradient is not manifest in the rather irregular graphs which represent Allen's Canberra results, but the corresponding shift in the phase angle of the 24-hour term comes out in harmonic analysis.

The effect of wind on the potential gradient at Mount Stromlo is curious. The gradient is comparatively small during calms and with very light winds but has its maximum value with winds of 5 m.p.h. A falling off with stronger winds occurs with south-east winds but not with north-west winds (these are the two prevailing currents). Allen endeavours to explain the minimum in calms by the 'electrode effect', but this explanation should, as he would be the first to admit, be tested by observation. The test would be straightforward, for the gradient as published is deduced from the potential difference between the ground and a collector at a height of 2.4 metres. If the 'electrode effect' is there, a higher value of the gradient would be found by using a collector only one metre above the ground.

Enough has been said to indicate the high value of Mr. Allen's memoir. It is to be hoped that his methods of analysing potential gradient records will be copied and extended elsewhere.

One curious detail must not be forgotten. It appears that in summer the sea breeze reaches Mount Stromlo in the early evening. The arrival of the sea-breeze is always marked by a drop in the potential gradient, and frequently there is a negative gradient for a few minutes. The more sudden and violent the wind change the more prominent is this effect. The gradient soon becomes positive again and is generally higher than previously. Is this evidence that at the head of the sea-breeze little whirlwinds are generated, raising dust which settles and leaves the air negatively electrified, so that a negative space charge is carried onwards for a considerable distance? It seems likely.

F. J. W. W.

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* Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 4: Atmospheric Potential Gradient Observations at the Commonwealth Observatory, Mount Stromlo, Canberra. By C. W. Allen. Pp. 47. (Canberra: Government Printer, 1934.)

Man's Place among the Primates

PROF. W. E. LE GROS CLARK, Dr. Lee's professor of anatomy in the University of Oxford, contributed a closely reasoned review of the present position of the questions of the evolution of man to the recent congress of Anthropological Sciences which is now published in full (*Man*, January). The main conclusions at which he arrives are summarised below.

The evidence suggests that one sub-order of the Primates, the Lemuroidæ, branched off at least at the very beginning of the Tertiary period from a basal primate stock which had been segregated from a generalised placental mammalian group in the Cretaceous period, and that any resemblance that it shows to the monkeys at later stages of its evolution is due to parallel development. Another sub-order, the Tarsioidea, also a branch from the basal primate stock, approximates much more closely in its evolutionary tendencies to those of the higher primates It is not improbable that the latter arose from fossil tarsioids in Eocene times, originating from the earliest and most primitive members of the group Some of the resemblances shown by the tarsioids to the monkeys are due to parallel evolution

The evidence also suggests that the monkeys diverged from the main stem of evolution very soon after the tarsioid stage had been passed Of all the primates, the anthropomorphous apes stand nearest to man structurally, but there is no reason for believing that they derive from a common ancestor so distant and so generalised that it would not come into the category of the anthropomorphs It is necessary to postulate an anthropomorph ancestry for modern man, though this does not mean that in the line of human descent there ever was a form which showed the characteristic specialisation of modern anthropoid apes such as the great elongation of the arms and degeneration of the thumb

It is certain that the earlier anthropomorphs were relatively generalised creatures, in which the primitive proportions of the limbs were still retained, and yet they would have shown a grade of development of brain, skull, dentition, etc, which would have entitled them to be called 'anthropoid apes'. There is every reason for supposing that man was initially derived from such a type The evidence of foot structure, as shown by Dr Morton in America, is decisive Structural features afford evidence that the foot of modern man is derived from a foot once used for grasping purposes.

At what stage in the evolutionary differentiation of the anthropomorphs did the human stem become segregated from that which led to the modern anthropoid apes ? The mandible and lower dentition of the fossil *Parapithecus* of lower Oligocene age are regarded by most as representing a small and very generalised member of the Anthropomorpha, which may have formed the basis for the development of the later types This may involve regarding the platyrrhine and catarrhine monkeys as precocious and specialised offshoots of the anthropomorphous stock.

Of the same geological age as *Parapithecus* is *Propliopithecus*, which so closely resembles the modern gibbon that it is included in the Hylobatidæ. Thus even in these early times the anthropoid apes were already undergoing rapid differentiation

It is generally conceived that man arose in Miocene times from a *Dryopithecus* stock which also gave rise to the modern African apes. Prof W K Gregory has shown that the human dentition was almost certainly derived from this type The human stock, however, has avoided modifications which are a necessary concomitant of brachiating habits, and it is improbable, therefore, that the direct ancestors of man practised brachiation to any considerable extent. The evidence suggests strongly that in the evolution of man the limbs attained to human proportions in advance of other parts of the human body In early types of man such as *Pithecanthropus* or *Sinanthropus*, while the skull and brain were astonishingly ape-like, the limb structure was closely comparable or even identical with that of *Homo sapiens*. The larger an animal becomes, the more difficult it is for that animal to adopt the upright posture, and hence the common ancestor of man and the apes must have been a comparatively small animal, that is, at a hylobatid rather than a giant anthropoid level.

This harmonises with the fact that the gibbon is the only animal which shows an erect bipedalism comparable with that of man The strikingly human characters of the large African apes must owe their origin to parallel evolution The general form of ancient types of man—*Pithecanthropus* and *Sinanthropus*—recalls the gibbon rather than the great apes If modern types of man did come into existence early in the Pleistocene, it is probable that the direct ancestors of man are to be found in the Miocene forms of *Dryopithecus*, already distinct from the line leading to the modern large anthropoid apes

The known remains of *Dryopithecus* are almost entirely limited to jaws and teeth, and it has been surmised that the skull was probably not unlike that of the African ape It may be, however, that future discoveries will show that it manifested characters shadowing in a much greater degree those of the Hominidæ If Schlosser's interpretation of the Eppelsheim femur as really belonging to *Dryopithecus* be correct, it indicates that *Dryopithecus* was much more adept in erect bipedalism than any of the great apes of to-day, and lends further support, therefore, to the conception that the precursors of the chimpanzee and gorilla set off on their own evolutionary adventures some considerable time before the dryopithecine precursors of man had come on the scene

Vitamin Standards

THE International Conference held in London in June 1931 under the auspices of the Permanent Commission on Biological Standardisation of the League of Nations Health Organisation recommended for international adoption standards and units for vitamins A, B_1, C and D, which were to be provisional for two years. As certain of the standard preparations were not available until 1932, the second Conference was postponed until 1934, when two years experience of the practical application of the standards would be available

The report of the second Conference, which was held in London in June 1934 under the chairmanship of Prof. E. Mellanby, has now been issued (*Quart. Bull. of the Health Organisation of the League of Nations*: Vol. 3, Extract No. 15 ; 1934). No change has been recommended in the standards for vitamins B_1 and D The former, which has perhaps proved the most satisfactory of all the standards recommended in 1931, is an adsorption product of the vitamin, extracted from rice polishings, on fuller's earth The unit is the activity of 10 mgm of the standard It was prepared in the Medical Laboratory, Batavia (Java) by the method of Seidell, as described by Jansen and Donath The standard for vitamin D, which was prepared at the National Institute for Medical Research, London, is a solution in oil of irradiated ergosterol The unit is the activity of 1 mgm of this solution, which has been found equal to that of 0·025 γ of crystalline vitamin D. It is recommended that when a new standard solution becomes necessary it should be replaced by a solution of the pure crystalline material in olive oil, of such strength that 1 mgm. contains 0·025 γ

The Conference recommends that pure β-carotene be adopted as the standard for vitamin A, in place of the present standard, which is a mixture of the isomers of carotene The value of the unit is unchanged and one such unit is contained in 0 6 γ of the new standard the old standard contained the same activity in 1 0 γ The standard preparation is to be issued in solution in a vegetable oil, in which it has been shown that it does not lose colour on incubation in the presence of air at 37° C for 7 days, the strength of the solution being such that 1 gm contains 500 units, or 300 γ of β-carotene The Conference report states that it has been found that measurement of the coefficient of absorption at 3280 A affords a reliable method for measuring the vitamin A content of liver oils and concentrates, and that the value obtained for $E^{1\ \mathrm{per\ cent}}_{1\ \mathrm{cm}}$ 3280 A can be converted into a figure representing units per gram by multiplying by the factor 1,600 This figure is the average of a series of comparative and independent tests on the unsaponifiable fractions of liver oils and on concentrates of high potency

For vitamin C the Conference recommends the adoption of *l*-ascorbic acid as standard, the unit being the activity of 0 05 mgm of the pure substance. (The previous standard was lemon juice, one unit being contained in 0 1 c c it has since been found that the potency of lemon juice varies, but the adoption of the new standard does not involve any significant change in the value of the unit) It was decided to ask the Institute of Medical Chemistry, Szeged, through Prof A Szent Györgyi, to prepare a batch of 500 gm of the standard and to ask Prof W. N Haworth to co-operate in controlling its purity

Among the subjects suggested for future work are the provision of a sample of cod liver oil as a subsidiary standard of reference for vitamins A and D and the investigation of the anomalous action on certain species of different sources of vitamin D

All the standards are kept at the National Institute for Medical Research, London, acting for this purpose as the central laboratory on behalf of the Health Organisation of the League of Nations

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University and Educational Intelligence

CAMBRIDGE —The General Board recommends that the following additional University teaching offices be established : (*a*) an assistant directorship of research in the Faculty of Economics and Politics , (*b*) an assistant directorship of research in colloid science , (*c*) a University lectureship in the Department of Mineralogy and Petrology ; (*d*) a University demonstratorship in agricultural engineering (subject to financial provision being made by the Ministry of Agriculture and Fisheries); (*e*) two University lectureships in the Department of Pathology , (*f*) a University lectureship in experimental psychology ; (*g*) a readership in industrial psychology (subject to the provision by the Medical Research Council of the stipend and pension contribution) ; (*h*) an assistant directorship of research in industrial psychology (subject to the provision by the Medical Research Council of the stipend and pension contribution)

EDINBURGH : On the recommendation of the Senatus, the Court has approved of the establishment of a Sharpey-Schafer lectureship in physiology, a fund for the endowment of this lectureship having been contributed by pupils and friends of Sir Edward Sharpey-Schafer The first of the lectures, to be given biennially, will be delivered in the coming summer term

LONDON —The Buckinghamshire County Council has decided to make a grant of £5,000, payable over ten years, towards the erection of new buildings in Bloomsbury

A grant of £2,000 has been made by the Pilgrim Trustees to the London School of Economics towards central expenditure on the Land Utilisation Survey. The grant, which is for staff salaries and the preparation of the report on the Survey, is estimated to cover the cost of completing the Survey as far as central expenditure is concerned. Local bodies and others are subscribing to local expenditure, and it is hoped that sufficient additional contributions from these sources will be obtained to complete the total cost of the work The Pilgrim Trustees have further given valuable assistance to the Survey by setting aside a sum of £1,000 which can be drawn upon as required by the London School of Economics to secure the continuance of the publication of the maps This sum is to be repaid by the School from the publication account of the Survey

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Science News a Century Ago

Walker's Eidouranion

"The Strand Theatre," said *The Times* of March 31, 1835, "from which Thalia and Melpomene have been banished by the Lord Chamberlain, has during Lent become the residence of Urania. Mr Walker, the well known popular lecturer, and perhaps the original lecturer, on the motion of the heavenly bodies and the phenomena of the planets, has commenced his very interesting lectures at this house. His lectures, and the reputation he has deservedly acquired by them, his apparatus and machinery, are so well known to almost all persons, that there is no need of giving a further description of them. They are in their contrivance elaborate and complex, but the illustration which they afford of the subject which he discusses is at once simple and intelligible The lecturer himself enters into his subject with a spirit of inquiry, and an earnestness of endeavour to familiarize science, which are very refreshing to those whose attempts at gaining information have been chilled by the technical formality of more stately teachers . At a time when the theatres are closed against dramatic performances the public cannot do better than devote a few hours to the acquirement of the scientific knowledge which these lectures, and similar lectures, convey and there can be little doubt that to the younger branches of the community they will convey that information to which young persons are exceedingly averse, unless it is conveyed in such a manner as to excite attention without distracting the understanding and wearying the patience " The lecturer was presumably Deane Franklin Walker (1778–1865) who, like his father Adam Walker (1731 ?–1821), lectured on science at Eton and Harrow and other public schools.

The Tides of the United Kingdom

On April 2, 1835, Whewell read a paper to the Royal Society entitled "On the Results of Tide

Observations, made in June 1834, at the Coast-Guard Stations in Great Britain and Ireland". Through representations made by Whewell, orders had been given for simultaneous observations of the tides at all the stations of the Preventive Service on *the coasts of England, Scotland and Ireland from* June 7 until June 22, 1834. The observations were sent to the Admiralty, and a part of them had been reduced From them Whewell had been able to deduce many important inferences. He found that the tides in question were not affected by any general irregularity having its origin in distant sources, but only by such causes as were merely local, and that therefore the tides admitted of exact determination with the aid of local meteorological corrections. The curves expressing the tides of high-water presented a very satisfactory agreement with theory A diurnal difference in the height of the tides, he said, manifests itself with remarkable constancy along a large portion of the coast under consideration The tide hour appeared to vary rapidly in rounding the main promontories on the coast, and very slowly in passing along the shores of the intervening bays, so that the co tidal lines are brought close together in the former cases, and in the latter run along nearly parallel to the shore, circumstances which would account for comparative differences of level and of corresponding velocities in the tide stream

Theories of Electricity

Prof William Ritchie (1790 1837), after being a schoolmaster in Scotland, went to Paris, where he studied under Thenard, Gay Lussac and Biot In 1829 he became professor of natural philosophy at the Royal Institution, and three years later was given a similar post in the University of London On April 3, 1835, he gave a lecture at the Royal Institution on the "Comparison of the two Theories of Electricity" The first of these theories, he explained, supposed that electrical phenomena depended upon the existence of a fluid universally diffused through matter and space, the particles of which repel each other inversely as the square of the distances If we abstract a portion of this fluid from a body, the latter becomes negatively electric, while if we add a portion, we produce the phenomena exhibited by positive electricity Another theory considered electricity to be a compound substance, consisting of two elements, positive and negative electricity None of the phenomena is observed until this fluid is decomposed, and then a portion of it goes to the attracted body Perhaps, said Prof Ritchie, the fluid may be the ether to which the phenomena of light seem attributable

The Dublin and Kingstown Railway

"The following is a statement," said the *Mechanics' Magazine* on April 4, 1835, "of the number of passengers, of different classes, conveyed along this railway during the first quarter of a year since it was opened, namely, from the 17th December 1834 to the 17th March 1835

1st Class fare,	1s each	10,008
2nd ditto	8d each	72,148
3rd ditto	6d. each	94,961
Total number of passengers		177,117

The whole of this immense number of passengers has been carried without the slightest accident of any sort. The receipts during the same period have amounted to £5,283 16s. 8d"

Societies and Academies

LONDON

Royal Society, March 21. D R. Hartree and W. Hartree Self-consistent field, with exchange, for beryllium. Fock's equations for the self-consistent field of an atom, including exchange effects, have been completely solved numerically for the normal state of neutral Be In connexion with the numerical calculations of energy values, a new check, depending on the direct calculation of the difference of energy values calculated using the solution of Fock's equations and using any other wave functions, is developed and applied The inclusion of the exchange terms has a small but appreciable effect on the (1*s*) wave function, which becomes more like that for the Be^{++} ion, and a considerable effect on the (2*s*) wave function, which contracts, and also becomes smaller near the origin compared to its maximum value These changes are qualitatively of a kind to bring calculated values of certain atomic properties into better accord with experiment. H R Hulme, J McDougall, R A Buckingham and R H Fowler The photo electric absorption of X rays in heavy elements A method is developed for finding the photo-electric absorption coefficient for the *K* shell, σ_K The calculations are rigorous and are not subject to the restriction $Z \ll 137$, where Z is the atomic number Theoretically it is possible to apply the method for all values of $h\nu$, the energy of the quantum absorbed, but, as a considerable amount of numerical work is necessary, it is not practical for large values of $h\nu/mc^2$ Values of σ_K are given for $h\nu/mc^2 = 0\ 693$ and 2 21 for elements with atomic numbers 26, 50 and 84 The values obtained do not differ much from those given by Hall, using a method which is discussed His expression has therefore been used for σ_K in the region $h\nu > 5mc^2$ and graphs have been *constructed giving the photoelectric absorption per atom* for various elements in the range $h\nu > 0\ 7mc^2$ or $3\ 4 \times 10^5$ e v The values obtained for lead are in excellent agreement with the experimental results as given by L. H Gray's empirical formula

DUBLIN

Royal Irish Academy, February 25 R ō Cinnéide Some 2 4 derivatives of thiophene 2-Thiophene carboxylic acid condenses with *N*-methylolamides to form derivatives of the general formula 2 4 $HOOC\ C_4H_2S\ CH_2NHCOR$ These derivatives, on acid hydrolysis, give the amino acid 2 4 $HOOC\ C_4H_2S\ CH_2NH_2$, which can readily be oxidised to the known acid 2 4 $C_4H_2S.(COOH)_2$ The hydroxy acid 2.4.$HOOC\ C_4H_2S.CH_2OH$ can also be obtained from the above amino-acid.

PARIS

Academy of Sciences, February 11 (*C R.*, **200**, 501 596). A Gosset. The partial longitudinal resection of the inferior vena cava in the course of the ablation of a right pararenal tumour. Description of a rare operation. Henri Lagatu and Louis Maume. Leaf diagnosis of tobacco The comparative influence of the scoria of dephosphoration, of superphosphate and of the basic phosphate on the PNK equilibrium Edouard Chatton and Mlle Berthe Biecheler *Amœbophrya* and *Hyalosaccus*: their evolutive cycle

The new order of the Cœlomastigina in the Flagellates Charles Poisson was elected *Correspondant* for the Section of Botany, in succession to the late William Morris Davis. E. J. Gumbel · The *m*th extreme values and the logarithm of the number of observations. Octav Onicescu and G Mihoc Chains of statistic variables Dimitri Perepelkine · The conformal transformation and the intrinsic normal Riemannian curvature of a V_m in V_n Serge Rossinski The deformation of a rectilinear congruence with conservation of the principal ruled surfaces Maurice Janet Two theorems on the relations between linear differential expressions André Weil · Topological demonstration of a fundamental theorem of Cartan Georges Valiron Systems of integral functions Armand Rauch The trend of integral algebroids in the paths of infinite determination Henri Poncin The stable hydrodynamical configurations which admit of surfaces of discontinuity for densities Daniel Belorizky A remarkable change in the radial velocity of the new star in Hercules The results of spectrographic measurements show that the radial velocity of this new star increased 230 km /sec in ten days Mlle M. A Baudot Generalisation of the equation of continuity and of the theorem of Liouville for a space of wave functions Paul Renaud A generalisation of Curie's principle of symmetry Jean Cayrel Comparative energetics of a two current system and a system of equivalent layers Willem Uyterhoeven and Cornelis Verburg The superficial effect [skin effect] in the positive column of a sodium-neon discharge René Planiol An arrangement for the production of ions in a high vacuum G Jouravsky, P Charczenko and G Choubert The residual induced magnetism of the eruptive rocks The residual magnetism of igneous rocks is largely due to magnetite After mechanical treatment by which the greater part of the magnetite is removed, the residual magnetism of the non-attracted portion is higher than would correspond to the proportion of magnetite remaining Albert Michel Lévy and Henri Muraour A light source of exceptional intensity and of very short duration By the explosion of a small quantity (0 4 c c) of a liquid explosive in an atmosphere of argon, a flash of light of very high intensity is obtained which lasts less than five millionths of a second The spectrum extends into the ultra-violet and promises to have useful applications. Fred Vlès A spectral property of electrolytes in solution Néda Marinesco and Mario Reggiani : The impression of photographic plates by ultra-sounds. The action of ultra sounds on a bromide plate free from any latent image results in the formation of a fine system of stationary waves. Mlle. Suzanne Veil Gelatine submitted to the action of an electric field. Study of the properties of gelatine after submitting to an electric field. There is a diminution in the electrical conductivity, and the anode region is positive with respect to the cathode region Mlle Cécile Stora The unsaturated character of colouring matters and the photo-voltaic phenomenon P Carré : The relative mobilities of the normal primary alkyl radicals from C_1 to C_{16} in their chlorosulphites The temperature of decomposition of the chlorosulphite in the presence of pyridine is taken as the measure of the mobility. The mobilities vary in the same direction from C_1 to C_7 : from C_8 to C_{16} they become lower than those of C_7, presenting odd-even alternation. Pierre Trunel . The permanent electric moments of some alkyl chlorosulphites. From measurements of the electric moments of alkyl chlorosulphites it is concluded that the structure remains the same for any value of *R* up to normal hexyl Michel Lesbre The action of the alkyl iodides on the alkaline plumbites Sodium plumbite reacts with methyl or ethyl iodide giving sodium iodide and a plumbonic acid, RPbO OH Antoine Willemart . Contribution to the study of the preparation of coloured hydrocarbons of the rubene type Pan Tcheng Kao A phenomenon shown in polarised light by quartz in vibration Ny Tsi-Ze and Tsien Ling-Chao The oscillations of a hollow quartz cylinder A hollow quartz cylinder can vibrate in four different ways In certain cases, the piezo electric quartz plate can be advantageously replaced by a hollow cylinder Louis Royer The orientation of lead chloride and bromide by muscovite mica Mlle Yvonne Boisse de Black New data on the constitution of the Puy Violent, an autonomous volcano of Cantal G Dubar and D Le Maitre The presence of Solenopores and Spongiomorphides in the Moroccan Lias Jean Legrand The utilisation of observations of the mean sea-level in the investigation of climatic cycles Pierre Gavaudan, Mme Noélie Gavaudan and Marcel Pelletier : The evolution and significance of the nucleolar apparatus in the somatic karyokinesis of some Angiosperms Raoul Combes The biochemical study of the flower The mineral nutrition of the corolla The comparative study of the corolla and leaf shows that the former is less mineralised than the leaf Marc Simonet The experimental synthesis of *Iris intermediares* Joseph Meierhans The pneumatic canal and the swim-bladder of the Physostome fishes Mme Julie Kostitzine . The female reproductive system of *Purpura lapillus* Lucien Plantefol and Georges Champetier The action of heavy water (deutohydrogen oxide) on reviviscent animals Armand Dehorne Cytological observations on a new species of Haplosporidium, parasite of the cœlom of *Nereis diversicolor* Gaston Ramon and Edouard Lemétayer The immunising action of the tetanic toxin, mixed with lanoline, on the experimental animal The toxin of tetanus mixed with lanoline and olive oil, after injection into the rabbit in quantities representing ten times the toxic dose, gave none of the symptoms of tetanus The rabbit was immunised against tetanus Constantin Levaditi, René Martin, Antoine Bonnefoi and Mlle Rachel Schoen The etiology of mumps

Sydney

Royal Society of New South Wales, December 5* G Harker . Note on the determination of traces of prussic acid in tissues Chelle's method involves the distillation of the prussic acid and its subsequent concentration in a small volume of potash solution, by removing it from the distillate with a current of air Owing to destruction of nearly half the prussic acid in the preliminary distillation process—a destruction which takes place also in the absence of tissue—the results were distinctly low The percentage loss, however, is fairly constant and an allowance can be made for it, leaving but a small margin of error The direct removal of the prussic acid from the tissue by a current of air gives higher yields except when less than 0 01 mgm prussic acid

* *Continued from p 484*

is present. **ADOLPH BOLLIGER** · The volumetric microdetermination of picrolonic acid in organic picrolonates with methylene blue Picrolonic acid forms with methylene blue a compound which is sparingly soluble in water (less than 0·001 per cent), but fairly soluble in chloroform (0·16 per cent). Thus picrolonic acid is so far the most soluble *o*-nitrohydroxyl compound for titration with methylene blue. The technique of the titration is the same as that described for picric acid or other *o*-nitrophenols The end point is very sharp Varying amounts of 0·01N picrolonic acid could be recovered with an error not exceeding 0·2 per cent Further, the picrolonates of α-naphthylamin, piperidin and *p* toluidin were examined for their picrolonic acid content by the method described. **P. M GAME** · Geology of the Cudgegong district. This paper describes a belt of country, 12–15 miles wide, extending south-eastwards from Mudgee for about 35 miles Upper Silurian and Middle and Upper Devonian strata are represented All three series are fossiliferous A great strike fault, following the Cudgegong valley, separates the Upper Silurian and Upper Devonian systems here, but elsewhere the three series are conformable with each other. They have been intruded by acid igneous types of the Kanimbla epoch, and are overlain unconformably by horizontal Kamilaroi and Triassic strata. Remnants of thick Tertiary sills and flows cap the highest hills, such as Mount Bocoble (sill), and Cumbermelon Mountain (flow) **S C BAKER** Testing a Lummer-Gehrcke interferometer, its use in a search for abnormality in the relative abundance of the isotopes of a special sample of mercury A cadmium-amalgam lamp of new design is described The relative intensities and half-value widths of the interference fringes of the cadmium red line were measured and compared with the theoretical values calculated from data of the apparatus Discrepancies are attributed to the experimental limitations The relative intensities of the hyperfine components of the green line emitted by two samples of mercury—one Australian, the other foreign—when excited by the high-frequency discharge differ by less than 2 per cent, which is within the limits of experimental error, so that there is no evidence of difference in the relative abundance of the isotopes of the two samples. **F. A. COOMBS, W. McGLYNN and M B WELCH** : The tannin content of a variety of *Acacia mollissima*, Willd. (4). A description is given of a variety of *Acacia mollissima*, black wattle, which occurs over a wide area of New South Wales Whilst the maximum tannin content found in seventeen analyses was found to be 51·5 per cent, the lowest was only 22·9 per cent It is evident that under favourable conditions this variety may yield a tan bark of high quality. **M B WELCH** The longitudinal variation of timber during seasoning (2) An examination was made of the longitudinal variation of some three hundred samples of a large number of different woods, in relationship to their densities While 66 per cent of the total samples swelled or remained stationary during drying from a green condition to the fibre saturation point, only 33 per cent behaved similarly from the fibre saturation point to an air-dry condition In general, woods of low density showed the greatest tendency to swell and heavy woods were more prone to remain stationary, during the initial drying period. Below the fibre saturation point, light timbers showed the greatest liability to shrinkage and heavy woods were inclined to remain stationary or to swell.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, April 1

BRITISH MUSEUM (NATURAL HISTORY), at 11 30.—J Ramsbottom "Symbiosis in Plants" *

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—Capt Gabel-Jorgensen "Dr Knud Rasmussen's Contribution to the Exploration of the S E Coast of Greenland"

Tuesday, April 2

LONDON NATURAL HISTORY SOCIETY, at 6 30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C 1)—Sir F. Gowland Hopkins "The Naturalist in the Laboratory" (Bacot Memorial Lecture)

Wednesday, April 3

SOCIETY OF ENGINEERS, at 6—(at the Royal Institution, Albemarle Street, W 1)—Sir William Bragg: "The Theoretical Strength of Materials and their Practical Weakness"

Thursday, April 4

INSTITUTION OF ELECTRICAL ENGINEERS, at 6—Prof. E W Marchant "Electricity in the Life of To-day" (Faraday Lecture)

Official Publications Received

GREAT BRITAIN AND IRELAND

Harper Adams Agricultural College, Newport, Shropshire Soil Survey of North Shropshire By W Morley Davies and G Owen Pp 33+2 plates (Newport Harper Adams Agricultural College)

The Board of Greenkeeping Research Report for 1934 Pp 44 (Bingley St Ives Research Station)

Proceedings of the Royal Society of Edinburgh, Session 1934–1935 Vol 55, Part 1, No 1 The Duration of Life in an Albino Rat Population By Dr B P Wiesner and N M Sheard Pp 22 2*s* Vol 55, Part 1, No 2 Dating of Late-Glacial Clay Varves in Scotland By Gerard De Geer Pp 23–26 6*d* Vol 55, Part 1, No 3 The Invariant Theory of the Correlation By Prof H W Turnbull. Pp 27–41 1*s* 3*d* (Edinburgh Robert Grant and Son, London. Williams and Norgate, Ltd)

OTHER COUNTRIES

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1934 Pp ii+152. (Bombay. Indian Central Cotton Committee) 2 rupees

Carnegie Museum, Pittsburgh, Pennsylvania Botany Pamphlet No 1 Poisonous Plants of Pennsylvania By Dr Edward H Graham Pp 16 (Pittsburg, Pa Carnegie Museum) 10 cents

I R I Broadcasts in conjunction with International Industrial Relations Institute Conference on Social Economic Planning, November 1934 Pp iv+40 (New York and The Hague International Industrial Relations Institute) 30 cents

Lac and the Indian Lac Research Institute By Dorothy Norris, P M Glover and Dr R W Aldis Pp iii+53+12 plates. (Nankum Indian Lac Research Institute) 2 8 rupees

Report of the Aeronautical Research Institute, Tokyo Imperial University No 117 On the Motion of High-pressure Powder Gases and Compression Waves in the Neighbourhood of a Muzzle of a Rifle By Kwan-ichi Terazawa, Mitsuo Tamano and Sin-iti Hattori Pp. 439–492+9 plates (Tokyo Koseikai Publishing Office) 75 sen

U S Department of Agriculture Circular No 342 The Waterfowl Flyways of North America By Frederick C Lincoln Pp 12 (Washington, D C Government Printing Office) 5 cents

The Hokkaido Imperial University. Calendar 1934–1935 Pp iv+240 (Sapporo Hokkaido Imperial University)

Education, India Education in India, 1932–33 Pp vii+117 (Delhi Manager of Publications) 2 8 rupees, 4*s* 6*d*

Kungl Svenska Vetenskapsakademiens Handlingar. Series 3, Band 14, No 2 Studies in the Genus *Astelia* Banks et Solander By C Skottsberg. Pp 106+24 plates (Stockholm Almquist and Wiksells Boktryckeri A-B) 10 00 kr

Astrophysica Norvegica Vol. 1, No 3 Measurements of Luminous Night Clouds in Norway 1933 and 1934 By Carl Størmer Pp 87–114+17 plates (Oslo · Jacob Dybwad)

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The Peoples of Britain

AT the present time, when racial questions are very much in the air, the proposal of the Royal Anthropological Institute for promoting a survey of the racial characters of the inhabitants of Great Britain is more than opportune It meets an urgent need in scientific investigation , and, incidentally, it will fill a serious gap in the common fund of established fact which makes up the background of public opinion Public policy recently has become involved in the discussion of a number of intricate and technical problems, with the result that clear thinking and clear definition were never a more urgent necessity than they are to-day It is here that the assistance of the anthropologist is invoked The importation of the racial question into international and national relations has opened a way to biased interpretation and racial prejudice which a statement of the facts and their direct implications alone can dispel

It is disconcerting to the anthropologist, and also perhaps humiliating to the dignity of his science, to reflect that one of the earliest, if not the first, survey of racial characters on a nation-wide scale was the outcome of political animosity The story is sufficiently well-known, but is worth recalling After the siege of Paris in 1870, in which the Muséum National d'Histoire naturelle was damaged by shell-fire—a catastrophe which, it is to be feared, we should not now regard with a like degree of surprise—de Quatrefages, the French anthropologist, while deploring the outrage, implied that it was congruous with the behaviour to be expected of Prussians, whom he demonstrated to be akin to the Mongolian Finns and, as such, barbarian intruders into Europe Amid the storm of controversy this statement aroused, the German Government countered with an order that the hair- and eye-colour of 6,000,000 German school children should be examined in the expectation that the facts thus elicited would be a sufficient refutation of the scandal It is, however, not uninteresting to note that Prof F G Parsons, who measured a large number of German prisoners during the War, found that their heads were considerably broader than the officially accepted figures, these latter emphasising the length and consequently Nordic character of the German head

Any light which a survey of the physical characters of the British population might throw upon current theories of European racial distinction would be incidental to, and implicated in, racial analysis of the material collected, rather than direct Yet understanding of the racial composition of the inhabitants of Britain must be dependent upon and must be brought into relation with the racial constituents of the population of Europe, with which, we know, it is historically connected In any event, the results of the survey must impart to public discussion a leaven of clear thinking, and at the same time reduce to a more correct proportion any arguments as to national cleavage on a racial basis which may be imported into political discussion It is fairly safe to anticipate that accurate knowledge of the facts will scarcely lend support to an exaggerated view of the importance of any one strain in a given population

Any such contributions to current thought, however, it may be repeated, must be regarded as a by-product of the proposed survey Its aim primarily will be to obtain a record of the facts relating to the population of Great Britain The need for this is sufficiently urgent The outline which appears in another column (p 530) of the attempts to promote an anthropometric survey of the British population, shows that it is now more than fifty years since any extended series of measurements of the people as a whole has been made. Individual observers have been at work up and down the country, more numerous perhaps than a summary reference would suggest, and studies have been made of special categories, such as university students, but these efforts have been unco-ordinated, and uniform methods have not been employed There have been important studies also of skeletal material, of which Prof F G. Parsons's examination of Saxon skulls aimed at being complete But of the earlier observations, it may be said generally, that they do not meet the requirements of modern methods of analysis, and often are not adequate for statistical treatment In some instances it was admitted at the time the measurements were first submitted for examination that their value had been impaired by the lack of training of the observer.

While the physical anthropologist is, therefore, in a position to put forward a strong plea for renewed activity in this branch of his science, activity which will both bring together such scattered material as is already available and will stand the test of modern standards of measurement, as well as extend it by fresh observations to a national survey, the needs of the student of British archæology are by no means to be overlooked The great advances in the study of British archæology during the last fifteen or twenty years have demonstrated that movements of culture and cultural changes in the prehistory of the British Isles can be demonstrated in far more refined detail and in far more complicated pattern than was ever dreamed in the theories of the broad cultural and racial movements of which our predecessors traced the ways For the decisive answer as to how far cultural distinctions correspond to racial movements—a correspondence which is often assumed—the archæologist must turn to the student of race, the physical anthropologist. Nor will the material for the reply be drawn exclusively from the skeletal material of past ages, for, as Prof H J Fleure has shown, the persistence of ancient racial characters in certain areas can be demonstrated with a certainty nearly beyond question This problem indeed is one of the most interesting upon which investigation may be expected to throw light Many years ago, Dr J Beddoe in a presidential address to the Anthropological Section of the British Association directed attention to the survival of pockets of the short dark population in areas otherwise predominantly tall and fair—he was speaking more particularly of his observations in the area of Bradford where the Association was then meeting As a germane issue, it will further be of moment to note how far it is possible to determine the persistence of type in the face of modern conditions of movement and of the contact of the population of areas once kept apart by difficulties of communication.

While it is not possible to specify the numerous problems upon which it may be expected that light will be thrown, it may be noted that a whole group of problems is connected with the trend of racial development, upon which it is at present possible to speak with some probability, but upon which a definitive verdict is desired Sir Arthur Keith, for example, has told us that he regards a nation as a race in process of formation, in other words, it is a unit of specialisation. Is there adequate evidence, as some would hold, that we in the British Isles are evolving out of the elements of our mixed physical heritage a special type differing from, though obviously related to, the racial strains of the European continent? Again, there is the change in the shape of the head. Prof Parsons maintains that the skulls of Londoners in the last two hundred and fifty years have undergone a process of broadening Is this true of the country generally or a phenomenon confined to London only? And in the latter event, is it due to the immigration of a broader strain or to other causes?

Although not part of the function of a racial inquiry as such, on a strict interpretation, it is clear that any evidence which may bear upon changes in the physical characters of the population is of the greatest moment on national grounds, especially if it can be correlated with evidence of a standard of health and the like The investigations of Prof Fleure and his colleagues in Wales, which seek to link up racial characters with the incidence of disease and other factors of social significance, do more than justify an appeal for public assistance towards the cost of the survey, which will be not inconsiderable Indeed, in the eyes of some, such inquiries, of which the survey is an essential preliminary, justify a claim for Government assistance A knowledge of the physical characters of the population of Britain is of the greatest interest to science, but it should be beyond the need of argument to show that it is of no less moment to the State

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Reviews

Geology and Mineral Wealth of Burma

(1) *The Geology of Burma* By Dr H L Chhibber, with Contributions by R Ramamirtham. Pp xxviii+538+26 plates (London · Macmillan and Co, Ltd, 1934) 30s net

(2) *The Mineral Resources of Burma* By Dr H. L Chhibber. Pp xv+320+10 plates (London Macmillan and Co, Ltd, 1934) 18s net

(1) THE need for a treatise on the geology of Burma has been felt for many years, not only by those interested particularly in that country, but also by geologists who study the earth's crust on broad structural lines, by palæobotanists and palæozoologists who trace the natural history of flora and fauna throughout geological ages on world-wide evidence, and by petrologists who correlate information from different petrographic provinces to enable them to establish generalisations of great importance with respect to the story of the rocks. The need has been greater in the case of Burma than almost any other portion of the globe, because that country is situated to the south and west of one of the most extensive parts of the earth's surface about which least is known geologically. Tibet, Mongolia and Siberia to the north, and Siam and China to the east, have never been surveyed by geologists, with the result that for many thousands of square miles in that part of the world, geological knowledge is scanty in the extreme and, unfortunately, likely to remain so for some generations. It thus becomes of the greatest importance to place on record the available geological data about the only part of this vast land-mass where geologists have for some years been at work.

An account of the geology of so extensive a country as Burma must necessarily be largely a compilation. A careful summary and critical analysis of the work of others by one who, like the author, is well-qualified for the task, is valuable in itself, but the importance of this volume is greatly enhanced by the fact that the author has himself surveyed geologically certain parts of the country, enabling him to correlate information from isolated areas and to give, for the first time, a general outline of the geology of most of the province, although there still remain important gaps, especially in some of the hill regions

The first three of the thirty-four chapters deal with physical features, river systems and lakes, chapters iv–ix with earthquakes, hot-springs, mud-volcanoes, denudation, limestone caves and the coast-line, chapters x–xxvi describe the geological formations from the Archean to Post-Tertiary deposits; chapters xxvii–xxxii give an account of igneous activities and petrological descriptions and chemical analyses of various types of rocks; chapter xxxiii gives a series of variation diagrams based on rock-analyses, and the final chapter contains much new information relating to the geotectonics of the country

The author, when recently in Great Britain, availed himself of the opportunity of consulting a number of eminent geologists on various branches of the subject, and was particularly fortunate in being able to incorporate two valuable appendixes, one on the correlation of the geology of Burma and Malaya specially written for this volume by J. B. Scrivenor, late director of the Geological Survey Department of the Federated Malay States, and the other on the correlation of the geology of Burma and Assam, by P Evans of the Burmah Oil Co.

The book is illustrated by twenty-three plates, thirty-seven figures and three geological maps in folder-form. A comprehensive, almost complete, list of references is added at the end of every chapter.

(2) Burma is one of the most important provinces of the Indian Empire as a source of minerals of economic importance, and with respect to petroleum, silver-lead-zinc ores, and tungsten ore it is the chief British producing country in the Far East. Indeed, during the War, its mineral production was of extreme importance. It supplied the Empire, for example, with most of the ore from which tungsten, needed for the manufacture of high-speed tools essential for munition purposes, was extracted. Deposits carrying gold, ores of tin and other base-metals, are mined in the country, and coal of an inferior quality occurs extensively. Its famous rubies and sapphires are still being mined, but on a considerably smaller scale than formerly, because of the success of their synthetic production.

It was a wise decision on the part of the author not to include an account of these important mineralised areas in the volume dealing with the geology, but to publish it as a separate book. Although the two subjects are complementary, large tracts of the country which are of geological interest contain no minerals of economic importance, these being very restricted in their distribution in Burma, as in most other countries. Mining engineers and mining geologists will be thankful for a work which, within 320 pages, deals with most of the hitherto known areas of mineralisation in a province of growing importance in its mineral production.

The first chapter describes the geological and geographical distribution of the mineral deposits with statistics of outputs for the period 1926–30. Figures for two later years could have been included. The remaining fifteen chapters deal separately with the different mineral occurrences, that on petroleum being by Dr. L. Dudley Stamp.

Because of the gold boom, much attention is being given at present to the occurrence of this metal in Burma. The chapter on gold, however, whilst containing useful and recent information, occupies only eight pages, which is out of proportion, for example, to the sixty-four pages devoted to the relatively less important mineral jadeite. Those interested in the wide distribution of gold in this province will be well advised to consult the valuable article on this subject by Dr. Coggin Brown, published this year in the first two issues of the *Mining Magazine*.

The book is illustrated by nine plates, thirteen figures, and a folder giving a sketch map showing the important mineral occurrences. It is well indexed, and bibliographies are given at the end of each chapter.

The format of the two volumes is all that could be desired.

W. R. JONES.

Faraday's Diary

Faraday's Diary: being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820–1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the Editorial Supervision of Thomas Martin. Vol. 5: *Sept. 6, 1847–Oct. 17, 1851.* Pp. xiii + 456 + 2 plates. (London: G. Bell and Sons, Ltd., 1934.) 7 vols., £12 12s. 0d. net.

AT the opening of the period covered by this—the fifth volume of Faraday's Diary—Faraday was fifty-five years of age, and signs of that failure of memory which clouded his later years were increasing. Thus, in the summer of 1847 we find, in a letter to Lord Auckland, complaints of giddiness, loss of memory and confusion. So to his faithful correspondent, Schonbein, he writes enthusiastically concerning ozone, but takes shame to "say that I have not yet repeated the experiments, but my head has been so giddy that my doctors have absolutely forbidden me the pleasure of working and thinking for a while, and so I am constrained to go out of town, be a hermit, and take absolute rest". Two years later, we find him writing to Matteucci to the effect that "I have lately been working for full six weeks trying to procure results, and have indeed produced them, but they are all negative. But the worst of it is that I find on looking back to my notes, that I ascertained all the same results experimentally eight or nine months ago, and had entirely forgotten them".

Illness and failure of memory combined make a sad handicap; nevertheless, Faraday's output of work—the rough notes of which fill more than four hundred and fifty pages of the published diary—was remarkably large, and in the fertile year 1850, he read no fewer than five papers before the Royal Society. Over and above this he gave, during the period 1847–51, courses of lectures on the allied phenomena of chemical and electrical forces, on static electricity, the Juvenile Lectures on the chemical history of a candle, Christmas Lectures on the forces of matter, and a course of six lectures on "some points of domestic chemical philosophy—a fire, a candle, a lamp, a chimney, a kettle, ashes". These, with Friday Evening Discourses, ranging from Schönbein's ozone to De la Rue's envelope machinery, represent a volume of work which would do no discredit to Faraday's great powers, even at their heyday.

Dominating the early part of this volume of the

Diary are the experiments on magnecrystallic action, initiated by a description of Plucker's experiments on crystals (he makes an odd occasional appearance in the Diary as Pluckner) In 1849–50 we have the record of the experiments on the relation of gravity to electricity, on diamagnetic action, on gases in the magnetic field, on magnetic conducting power and on atmospheric magnetism , the year 1851 provides the data for the twenty-eighth and twenty-ninth (the last) series of Experimental Researches, on lines of magnetic force and on the employment of the induced magneto-electric current as a test and measure of magnetic forces

To this period belongs the introduction of the terms *paramagnetic* and *diamagnetic*, due to Whewell, who writes to Faraday in July 1850 · "The purists would certainly object to the opposition of *ferro-magnetic* and *dia-magnetic* it would appear that the two classes of magnetic bodies are those which place their length *parallel* . . to the terrestrial magnetic lines, and those which place their length transverse to such lines Keeping the preposition *dia* for the latter, the preposition *para* or *ana* might be used for the former Perhaps *para* would be best, as the word *parallel* would be a technical memory for it"

It will be seen that the Diary shows little falling-away in the intrinsic interest of its contents It is superfluous to add that this volume, in the matters of editing and of printing, preserves the high standard of its predecessors A F

The Teaching of Geography

Memorandum on the Teaching of Geography Issued by the Incorporated Association of Assistant Masters in Secondary Schools Pp xvi+418 (London · George Philip and Son, Ltd , Liverpool · Philip, Son and Nephew, Ltd , 1935) 7*s*. 6*d*

THE established place which geography has taken in the educational curriculum during the last thirty years has been gained by a revolutionary change in the outlook of the subject From a mere recital of place names and uncorrelated facts, disliked by both teacher and pupil, it has developed into a study of the interrelationships of various distributions on the earth's surface and their relation to human activity

The time is opportune for this review of the scope and position of the subject, which has been made by a representative committee of teachers In discussing the aim of the work, the committee stresses the value of geography as a unifying subject, correlating not only various scientific studies, but also giving a link between humanistic and scientific sides of the curriculum While the utilitarian side of geography is not overlooked, the committee stresses rather the cultural aspect, inasmuch as geography properly taught gives a view of the world as a whole and provides a background for a true appreciation of local peculiarities and national aspirations It deprecates the teaching of economic geography as apart from regional treatment of the world as giving a non-geographical bias It might have added a warning against the tendency of many textbooks and some teachers to regard the world merely as a field for industrial exploitation

After discussing a scheme of work for schools, in which the committee advocates the teaching of physical geography as incidental to human interests rather than as an end in itself, the necessity of noting historical factors in many geographical topics is pointed out, for example, the woollen industry, and thus providing the opportunity of linking history with geography This is a more satisfactory plan than the attempt to teach historical geography by itself, which may lead to the pitfalls of over-generalisation and exaggeration of 'geographical control'

In useful chapters on teaching methods and apparatus the value of the globe as correcting misconceptions due to flat maps is noted Possibly more attention might have been given to the nature of wall maps and atlases, of which many produced for school use are crude and over-generalised A list of books suitable for the school library is not intended to be exhaustive, but the inclusion of several might be criticised In a discussion on the training of teachers, the value of travel is an important point raised This is rightly said to be as necessary to teachers of geography as to teachers of modern languages, to whom it is generally conceded

A long chapter on examinations contains many criticisms and suggestions that should be helpful to examiners who are conscious of the pitfalls which beset them The committee believes in easy papers with a high standard of marking It gives a cautious acceptance to the new style of paper which certain examination boards are now trying These papers in their demand for factual knowledge and discouragement of critical answers destroy initiative and penalise the bright candidate at the expense of the dull one The greater possibilities of standardising the marking of a number of examiners seems to be the chief, if not the only merit of this type of papers Their acceptance would mark a distinct reversion to the old and non-educational aspect of geography. The volume concludes with a careful bibliography of geography teaching R N R B

A Course of Psychology

The New Field of Psychology the Psychological Functions and their Government By Prof Madison Bentley. Pp xvi+439 (New York and London · D Appleton-Century Co, Inc, 1934) 12*s*. 6*d* net.

PROF MADISON BENTLEY has chosen an ambiguous and even a misleading title for his book To most people the phrase "the new field of psychology" will suggest a study of one or more of the many recent movements in psychological science. In fact, as all psychologists know, Dr. Bentley published a book called "The Field of Psychology" some time ago, and this volume is simply a very thorough revision of that.

The author now ceases to discuss anything in terms of 'mental' events, processes, or forms of existence, and writes only of functions. The functions of the living organism, he holds, can be studied in two ways as chemical and biological processes which run their course within the bodily organism itself, and as psychological processes which cannot apparently be very clearly defined, but all of which involve some direct interplay between the body and what goes on outside the body Psychological functions he considers to be of three main varieties, those which further *apprehending*, those which carry out *action*, and those which lead to *comprehension* All these are closely related to the physiological functions, and must be regarded as growing out of them, and as based upon them. With this general scheme he discusses all the usual questions raised in a functional psychology.

The book is a textbook, and appears to be intended to cover the requirements of an introductory but comprehensive course. It consists of printed lectures, and it has much of the discursiveness and illustrative character of the lecture form Students and teachers are likely to get a little weary of it before they have finished, and to look for some presentation more direct and condensed. But of course it is well informed, it is generally clear, and it has the high merit, in a general psychological textbook, of complete consistency

Dr Bentley has printed seventy pages of footnotes to his lectures. Both the teacher, and the student who already knows something of psychological investigations, will find these far and away the most interesting part of the work. It is here that the author discusses the views of other people, and indicates the sort of reading that he would wish his students to undertake His expositions are sometimes arresting, his criticisms usually exceedingly good and not by any means always the conventional ones, and his selected authorities excellently chosen.

Short Notices

Russian Sociology: a Contribution to the History of Sociological Thought and Theory By Dr. Julius F. Hecker. Pp. xvi+313. (London Chapman and Hall, Ltd., 1934) 8*s*. 6*d* net.

THE writings of nearly thirty social philosophers are reviewed and summarised by Dr. Hecker in this book, which is re-issued after nineteen years Its general tendency will soon be obvious to the reader, especially if he turns towards the latter part of the volume, but it should be observed at once that the review covers the work of many other thinkers than those belonging to the later phase of dialectical materialism So far as it does this, it both increases the value of the book and the ease of the reader.

True and interesting remarks flash out here and there, and one is always curious to see how the generally accepted facts of the modern industrial State are met by the abstract theorist, whether of the Lenin or any other school. Mikalovsky, for example (fl. 1842–1904), said quite truly that, "Atrophy of the physical or the mental characteristics of man is possible through social or economic subdivision of labour". Bogdanov, the later and more purely theoretical writer (fl. 1873–1928), suggests that this may be corrected, "for the further increase in the complexity of machinery and the growing intelligence of the workers will eventually remove the final vestige of specialization Organizer and worker will merge into one"—a cryptic remark akin to the still more famous Marxian dogma that action and thought are identical. More definite is Bogdanov's criticism of the Marxian doctrine that the ruling class owed its position to the ownership of the means of production; Bogdanov would find it rather in the power of organisation. He is also the first exponent of 'tectology', or 'organisation-science', claiming for man the power to organise the "outer forces of nature, as well as human forces and experience itself". Here is the philosophy of a national plan in its germinal and most general form. The result of such organisation, especially in its Russian shape, we are all awaiting with interest; that it can contain much of the personal liberty which so many of these writers so ardently desire, is the most doubtful point. F. S. M

Geologic Structures. By Bailey Willis and Robin Willis Third edition, revised. Pp. xviii+544 (New York and London: McGraw-Hill Book Co, Inc., 1934.) 24*s*. net.

THIS book was first published in 1923 and a second edition appeared in 1929. In the third and latest edition the text has been completely rewritten and rearranged, while some fifty additional maps and figures have been added. As a result, the value of the book has been considerably enhanced, and in its new form it is undoubtedly the most exhaustive treatise on structural geology in the English language.

The subject is treated from a descriptive and analytical point of view and there is a conspicuous absence of the confusing mass of theory and hypothesis with which the literature of tectonics is so overburdened. The descriptive portion of the book is preceded by a discussion of the fundamental mechanical principles involved in the deformation of rock masses. The description of each type of structure (folding, faulting, etc.) is followed directly by a detailed analysis of the stresses and strains involved in its production.

New chapters have been added on "The Physiographic Expression of Structure" and on "Practical Problems", while the section dealing with the wider problems of earth dynamics has been completely rewritten and affords an excellent account of modern views concerning the nature, age, constitution and physical and thermal state of the earth.

Although the book is of a detailed and systematic nature it is equally suited to the needs of the elementary student and the advanced worker, since the purely descriptive and the analytical sections respectively are treated separately, as indicated in the table of contents.

A Hundred Years of Psychology, 1833–1933. By Prof. J. C. Flugel. (100 Years Series.) Pp. 384. (London: Gerald Duckworth and Co., Ltd., 1933.) 15*s.* net.

THIS important book fills a very obvious gap in psychological literature, and will serve for many years as the most useful outline, although in no way sketchy, of psychology during its period of most energetic development.

The author begins by giving a vivid picture of the position a hundred years ago, when Herbart's works had laid the foundation of psychology as a subject in its own right. The next part surveys the period up to 1860, showing the rise of systematic, physiological and abnormal psychology. During the next period, that is, up to 1900, the influence of the theory of evolution was felt, and psychology was applied to problems of the individual, the child and the animals; a period that experienced the activities of Spencer, Galton, Wm. James, Fechner, Helmholtz, Wundt, Charcot and Ribot, to mention only a few names, was clearly one of rapid development.

During the last thirty-three years there has been a tendency for schools to develop, each probably feeling much more in opposition to the others than will later prove to be the case. The most outstanding characteristic of this period has been the fruitful application of psychology to education, industry and medicine.

Unlike so many shorter histories, this book is interestingly written and should be read by all students of psychology, who will gain much from seeing their own speciality in perspective and treated in an unbiased way.

Geometrische Elektronenoptik: Grundlagen und Anwendungen. Von E. Bruche und O. Scherzer. Pp. xii+332. (Berlin: Julius Springer, 1934.) 28.40 gold marks.

ELECTRONS behave in many respects like light. They may travel in straight lines; may be 'refracted' in electric or magnetic fields, may be focused as by a lens in suitably graded fields, or may be caused to produce interference patterns in properly disposed apparatus. These are the matters which the authors of this book have chosen for their topic, and which they have elaborated with most praiseworthy attention to detail and extreme completeness of reference.

Almost exactly the first half of the volume (164 pages) is devoted to the more mathematical and theoretical parts of the subject, while the second half (165 pages) is concerned with the more practical applications. Commencing with the formal analogy between light waves and electrons, the authors proceed in logical manner to develop the theory of the motion of electrons in electric and magnetic fields, including a very complete mathematical discussion of 'electron lenses'. The experimental side of the subject is always kept in view.

In the second half of the book the development of the original Braun tube to the present-day cathode ray oscillograph is first detailed, followed by a long chapter on the 'electron microscope'. A very interesting set of comparison photographs of the same objects taken through the ordinary light microscope and the new electron microscope allow the reader to form his own conclusions about the present state of the new technique in relation to the old.

Herbert Spencer's Sociology: a Study in the History of Social Theory, to which is appended a Bibliography of Spencer and his Work. By Dr. J. Rumney. (Herbert Spencer's "Descriptive Sociology", continued by his Trustees.) (Published for Herbert Spencer's Trustees.) Pp. xvi+357. (London: Williams and Norgate, Ltd., 1934.) 10*s.* 6*d.* net.

THE winding up of the trust created under the will of Herbert Spencer for the publication of sociological material relating to the less advanced societies has been fittingly marked by the Trustees in the publication of this account of Herbert Spencer's sociological work. Dr. Rumney, to whom they entrusted the task, has wisely not confined himself to a summary of Spencer's theories, but has analysed them critically in the light of modern developments in theory and method.

Spencer has not received a very cordial welcome in academic circles, and it will perhaps come as a surprise to many who have not an extensive acquaintance at first hand with his writings to find how well they stand the test. Dr. Rumney finds the main ground of criticism in the attention given to structure rather than function and in the neglect of modern or civilised societies in favour of primitive or archaic forms. The explanation of the latter failing, as he points out, is that in the days in which Spencer was working it was erroneously believed that the 'savage society is the simpler—a fallacy exposed by modern research.

Mathematical Biophysics

By N. RASHEVSKY, Department of Physiology, University of Chicago

THE application of physico-mathematical methods to biology has been advocated now and again by scientific workers; but until recently no systematic attempt to create a mathematical biology has been made, and the advocates of this 'science to come' have confined themselves to outlining the possibilities of such an approach. True, there is a wealth of literature on the application of mathematical statistics to various biological phenomena; but the whole of this field of research lacks almost completely the physical point of view. General physics is accepted as of paramount importance in the study of biological phenomena; the application of physical methods has already resulted in important biological discoveries. But most of this application is restricted to the use of physical apparatus in biological experiment; and very little attempt has been made to gain an insight into the physico-chemical basis of life, similar to the fundamental insight of the physicist into the intimate details of atomic phenomena. Such an insight is possible only by mathematical analysis; for our experiments do not and cannot reveal those hidden fundamental properties of Nature. It is through mathematical analysis that we must *infer*, from the wealth of known, relatively coarse facts, to the much finer, not directly accessible fundamentals. The greatest advances of modern physics are due to such men as Einstein, Bohr, Heisenberg, Dirac, who unravel the mysteries of the physical universe by the power of their thought, using mathematics as their tool.

The objection has been frequently raised that mathematical methods, however useful in physical science, are inapplicable to biology, because of the tremendous complexity of biological phenomena. But this argument should really be used in favour of, rather than against, the application of mathematics to biology. A simple phenomenon can be understood by mere 'inspection', but it requires mathematical analysis to see through a complex system. The main thing is to apply mathematics methodologically correctly, by first studying abstract, over-simplified cases, which may even perhaps have no counterpart in reality. Afterwards the various complexities of the case have to be taken into account gradually, as second, third and higher approximations. This use of abstract conceptions in the beginning is *the* characteristic of the physico-mathematical method. Violation of this rule, and all attempts to start with actual cases in all their complexity, result in failure and have contributed to a sceptical attitude towards mathematical methods*.

The following brief review of my own researches in mathematical biophysics may serve to illustrate the fruitfulness of a mathematical approach to this field.

The fundamental living unit is the cell; hence it is with the study of a cell that we must begin. But, faithful to our rule, we must start with a mathematical description not of any given type of actual cell, but of an abstract concept of a cell. Not only are there innumerable varieties of cells, but also no two cells are quite alike. They differ in size and structure and chemical composition. Most of them possess a nucleus; some have several, others have none. Some cells consume oxygen, some not. Some metabolise one type of substance, others a different type. If we discard all such properties of a cell as are not common to absolutely *all* cells, we arrive at the following definition of a cell, which holds for *all* cells whatsoever and which we take as defining our abstract conception of a cell.

A cell is a small liquid or semi-liquid system, in which physico-chemical reactions are taking place, so that some substances enter into it from the surrounding medium and are transformed, through those reactions, into other substances. Some of these other substances remain within the system, causing it to increase in size; some diffuse outwards.

Such a system is no longer so complex as to forbid any application of mathematical analysis, and we shall proceed to investigate mathematically various properties of such systems, or in other words, various consequences of the above definition.

At a first glance not much can be done with such a general definition, but actual analysis shows quite the opposite. As in geometry extremely simple axioms and definitions lead us to very complex propositions by reasoning, so will the same mathematical reasoning lead to important conclusions from the above definition of the cell[1].

First of all, it is easily demonstrated that whenever a system consumes or absorbs any kind of substance in solution in the surrounding medium, the concentration of this substance will not remain uniform, either in the system itself, or in the surrounding medium. The concentration outside of the system will have a gradient towards the system; in the system itself there will be a gradient from the periphery towards the inside. The reverse holds true whenever the system produces a substance which diffuses outwards into the *milieu externe*. The concentration will be greatest inside, and will decrease towards the periphery, and will then further decrease with increasing distance from the system. The exact variation of the concentrations from point to point will depend on a number of factors, such as the size and shape of the system, the diffusion constants inside and outside, the permeability of the boundary, the type of reaction producing the gradient, etc. But whenever a reaction producing or absorbing a substance takes place in the system, *as is always the case with a living cell*, such gradients of concentration are present.

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* Cf. my article in "Philosophy of Science", 1, 176; 1934.

Any dissolved substance produces an osmotic pressure, which for dilute solutions is proportional to the concentration of the solute; hence, whenever concentration gradients are present, they result in non-uniformity of osmotic pressure. This in its turn results in forces, acting on each element of volume, and proportional to the gradients of pressure. Thus the very general and simple fact that *every cell metabolises* leads to the existence of a system of forces within and without the cell. Like the gradients of concentration, the exact distribution of these forces will vary from case to case; but they are always there.

Having thus deduced the existence of these forces, we must now investigate their possible effects. To this end we must investigate various possible cases, which open up an unexplored field to the mathematician.

We start with the simple case of a spherical homogeneous cell, which either absorbs or produces some substance at a constant rate per unit volume: this rate being independent of the concentration of the substance. The distribution of concentrations within and without the cell has in this case a spherical symmetry and can be easily calculated: the resultant force will be *zero*. But things are different if the cell is slightly deformed from its spherical shape. Mathematical investigation of the forces produced by such a deformed cell shows that, for substances absorbed by the cell, the forces are such as tend to restore the spherical shape; but for substances which are produced by the cell, the forces are such that they tend to increase the departure from the spherical and to *divide* the cell into smaller ones. Since in an actual cell substances are both produced and absorbed, the net result will depend on which forces prevail. This, again, is determined by various physical constants of the cell, the rates of reaction, etc.

Let us consider the more interesting case, when the *dividing* forces prevail. It can be shown that even in this case the cell will only become unstable and divide spontaneously when its size is greater than a certain critical value; for when the cell is below that size, surface tension, which opposes division, always prevails. This critical size can be calculated in terms of the above-mentioned constants of the cell. Although we do not know these constants with any accuracy, we have a fair knowledge of their order of magnitude, and can estimate the order of magnitude of the critical size at which a cell will divide, if it divides at all. The sizes thus calculated happen to be the same as the sizes of actual living cells[2]. We thus see that, merely by virtue of its metabolism, every cell contains in itself factors which may cause its division into two, whensoever in the course of its growth it comes to exceed a definite critical size. The half-cells grow on until they in turn divide, and so on.

As our next step, we must consider more complex cases of cells consisting of two phases, nucleus and cytoplasm. The mathematical treatment here becomes much more complicated, but the general results remain the same.

A further step leads us to non-spherical cells. At a first glance the existence of free, non-supported, liquid systems with a non-spherical shape sounds like nonsense, since we know from the laws of capillarity that in such a case the only stable shape of equilibrium is a sphere. But this holds true only when forces other than a *constant* surface tension are absent. Now, the presence of concentration gradients produces non-uniformities in the surface tension of the cell; this modifies the situation and makes non-spherical shapes of equilibria possible. But those non-spherical shapes are possible *only* so long as the cell metabolises; as soon as the cell dies its metabolism stops, the gradients disappear and the cell assumes a spherical shape. An illustration of this is found in many unicellular organisms, which possess oblong and sometimes eccentric shapes during life, but round up after death[3].

We have seen that the forces discussed above do not always produce division of the cell. In such a case, however, a cell will not grow indefinitely. As it increases its specific surface decreases, and the relative rate of growth decreases too. A stage will be reached when anabolism just balances katabolism, and no further growth will result.

The osmotic forces are not the only ones produced by concentration gradients. Other forces, due to attraction between various molecules, enter into play whenever concentration gradients are present. These forces may be of opposite sign to the osmotic ones. Taking them into account makes the whole picture much more complex, but the general conclusions remain as given above. We see that our apparently simple definition of a cell necessarily implies a complexity reminding one of the actual conditions in biological systems ![3]

An objection has been raised to all the above considerations that, in actual cells, protoplasmic streamings are often observed, which should stir the interior of the cell and even out the concentration gradients. This objection is based on fallacy. Not only does the existence of protoplasmic streaming constitute no argument against the existence of gradients, but it is a positive proof for their existence. Where there are streamings, there are the forces which produce them; and if everything were homogeneous, no such forces could be produced. It is true that the occurrence of streamings will modify the distribution of forces, and so far this complication has not been taken into account; it is one of the next problems on our programme. It has been already suggested that such a further generalisation of the theory may throw light on the mechanism of locomotion in the Protozoa.

Thus far we have been considering the effect of the forces produced by the cell on the cell itself, but the concentration gradients outside the cell result also in forces between one cell and another. All those forces being of the same origin, there is a close relation between them. Whenever we have an aggregate of cells in which the dividing factors prevail, they will repel each other. On the other hand, when the 'restoring' factors prevail, cells attract each other. Of all cells, the neurones have most completely lost their property of dividing; we should expect forces of attraction between them. Indeed the existence of such forces has been inferred by a number of neurologists, notably Ariens Kappers and Ramon y Cajal, from various observations. The peculiar irregularity in shape of the neurones and the existence of a great number of interneuronic connexions is also to be accounted for by those forces. It has been suggested that a formation of new anatomical connexions between neurones may be the cause of conditioned reflexes and learning. Calculation shows that the above forces may account for it. Under certain conditions they will produce an actual new connexion in a very small fraction of a second.

This leads us towards a mathematical theory of nervous functions. We find that, under very general conditions, aggregates of cells such as are studied above will possess many properties characteristic of the brain. These include differential discrimination of spatial and temporal patterns by learning, and what is known in psychology as 'Gestalt-transposition'. For details we must refer to the original papers[4].

Finally, the theory of intercellular forces has been applied to the form of cellular aggregates, forming multicellular organisms. It has been shown that those forces account in a general way for the various stages of embryonic development (blastula, gastrula, neurula), and for the gross features of the forms of various classes of animals[5].

Having thus started from a study of the most general properties of a cell, we arrive in a deductive, synthetic way at a possible understanding of such problems as "why we behave as we do" and "why we are shaped as we are".

We have not mentioned at all the 'mechanism-vitalism' controversy. The problems discussed here are entirely independent of its issue, if there be an issue[6]. Whether the present-day concepts of physics will prove sufficient to provide an exhaustive explanation of life, or whether new principles will be introduced in the future, the treatment of those problems will of necessity be mathematical, if it is to be exact and scientific and not to resolve itself into mere verbal disputes.

Much remains to be done, but there can be little doubt of the fruitfulness of this approach. The further we proceed, the more difficult become the mathematics involved; but the results compensate for all difficulties. C. F. Gauss, "rex mathematicorum", derived many an inspiration for his purely mathematical discoveries from the study of physical phenomena. The time has come when mathematicians may find their problems in the ever-inspiring realm of living Nature.

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[1] *Protoplasma*, **14**, 99, 1931; **15**, 427, 1932; **16**, 387, 1932. *Physics*, **1**, 143, 1931.

[2] Cold Spring Harbor Symposia on Quantitative Biology, **2**, 1934.

[3] *Physics*, l.c.

[4] Forthcoming in "Philosophy of Science" and in the *Journal of General Psychology*.

[5] Protoplasma, **20**, 180; 1933.

[6] Cf. concluding paragraphs in "Philosophy of Science", l.c.

Racial Studies in Britain

THE proposals put forward by the Royal Anthropological Institute for an organised anthropometric survey of Great Britain (see NATURE, 135, 463, 1935) revives a project in anthropological research of which too little has been heard in recent years. It is a project which has had a curiously chequered history; and its fate up to the present has been less than is deserved both by its intrinsic merits and by the enthusiasm and strenuous efforts of those who, from time to time, have endeavoured to bring it to practical effect. The story covers more than half a century of the comparatively short history of anthropology as a science.

The racial history of Britain begins in what is now called pre-history with the studies of prehistoric skeletal material by Barnard Davis, Thurnam and Rolleston From this emerged the concept of a racial succession of long-heads and broad-heads of the stone and bronze ages with the long-headed Saxons and intruding Danes as an overlying element in the building up of the population Even before the publication of Thurnam and Davis's "Crania Britannica" in 1865, Dr John Beddoe had been at work in the 'fifties, collecting particulars of hair- and eye-colour in Scotland, Ireland and England, which he was afterwards to utilise in his "Races of Britain" But the first organised attempt at measurement of the living on an extended scale was made by the Anthropometric Committee of the British Association which reported in 1878 and succeeding years and in 1883 published a comprehensive final report, to which reference is sometimes made under the name of its secretary, C Roberts, who was responsible with Sir Rawson W Rawson for its compilation Notwithstanding the lapse of time, and in some instances the uncertainty of conclusions based upon insufficient data, this is still the standard of reference for any comprehensive account of measurements of the living in the British Isles

Various attempts, mostly somewhat spasmodic, were made to keep alive the work of the Anthropometric Committee Francis Galton measured 10,000 individuals at the International Health Exhibition of 1884, and a laboratory which he instituted at the South Kensington Museum with an elaborate programme of observations was in existence for some years. From the Manchester meeting of the British Association in 1887 until the Nottingham meeting in 1893, measurements were taken of such of the members of the Association as visited a temporary laboratory set up at each meeting under the care of a committee which reported annually Other British Association Committees were appointed from time to time A committee on the measurement of children became a committee for the study of the abnormal and, acting in co-operation with a committee appointed by the International Congress of Hygiene of 1891, recorded the observation of 30,000 children in 1892-93 and helped to secure the special treatment of the defective child; while a committee to promote anthropometric measurements in schools collected a certain amount of information, aroused some enthusiasm, but failed to initiate any general or extended action. Anthropometric observation also formed part of the extensive programme of a committee for the ethnographic survey of Great Britain appointed in 1892, which published five reports between that date and 1899, when it ceased to exist in favour of a proposal for an Ethnographic Bureau for Great Britain

Following this, the most serious effort in promoting anthropometric research was made early in the twentieth century by another Anthropometric Committee of the British Association appointed in 1902, which, although it did not carry out measurements on the living as was originally intended, nevertheless had an important influence on the further development of anthropometric observation This it achieved in the first place by drawing up under the chairmanship of D J Cunningham a code of instructions for anthropometric measurement, which, whatever its defects may have appeared to be to a later generation, secured the standardisation of a technique which was in advance of that of its day, and secondly by its efforts, and more particularly the efforts of individual members of the committee, to secure the recognition of an anthropometric survey of the inhabitants of Britain as a work of national importance, which should be supported by a subvention or even undertaken as a national charge

In the latter of these two activities of the Committee one member was indefatigable This was John Gray, its secretary throughout the whole of its existence A native of Aberdeenshire, he had taken up anthropometric work in the 'nineties, when he used to visit the fairs and other countryside gatherings in Buchan and record the physical measurements and characters of those who attended them His early contributions to anthropometric research were studies of the material thus obtained, which were submitted to the Buchan Field Club In this work he was soon joined by Mr J F Tocher, then of Peterhead, who made an ethnographical study of the school children of Buchan, which was also communicated to the Field Club. This work had one important consequence It brought the two men into touch with Sir William Turner, himself a famous craniologist and then professor of anatomy in the University of Edinburgh, through whose influence they were able to obtain financial assistance for their further work of anthropometric survey, one outcome of which was the important and authoritative study of the physical characters of the inmates of the asylums of Scotland.

It is not so much Gray's work as a persistent measurer of heads on all occasions, suitable or otherwise, or his ingenuity in devising 'fool-proof' anthropometric instruments, with which we are concerned here, as with his unobtrusive but determined and unceasing efforts to secure public recognition of the value of anthropometry, more especially in its application to the population problem of Britain A word, however, must be spared for his early appreciation of the significance of biometric methods in anthropology. Like C. S Myers, whose paper on "The Future of Anthropometry' in 1903 has been regarded as a landmark, he recognised that much early work in physical anthropology was vitiated by the insufficiency of the data on which its conclusions were based, and advocated the employment, and himself consistently employed, sound statistical methods on the lines of Prof Karl Pearson's work, in the critical treatment of the data of the observer

It is not proposed here to attempt an examination of the contribution of the biometric school to the racial history of the British population, of which a brilliant example has recently come from the pen of Dr G M Morant For one reason it stands somewhat outside the movement now under consideration, though, it is to be judged, under the present proposals of the Royal Anthropological Institute, a more or less complete fusion of material from both sides will now take place

At about the time of the appointment of the last-named of the Anthropometric Committees of the British Association mentioned above, the people of Great Britain were much alarmed, so far as was to be gauged from the daily Press, by the alleged fact of a serious physical deterioration in the population and a marked inferiority of development among the children of the less well-to-do in the community. In part this was an aftermath of the Boer War, not unconnected with difficulties in recruiting for the Army Largely as a result of newspaper agitation, an Inter-Departmental Committee was set up to inquire into the matter Among those invited to give evidence before this Committee were several anthropologists, including D J Cunningham, chairman of the Anthropometric Committee and by now professor of anatomy in the University of Edinburgh

The Inter-Departmental Committee issued its report in 1904 Almost immediately afterwards the British Association met at Cambridge, where a full-dress discussion of the situation took place in Section H (Anthropology) under the presidency of Mr Henry Balfour, at which the Right Hon Arthur J. Balfour (afterwards Earl Balfour), then Prime Minister and president of the Association, was present. The most noteworthy features in the discussion were a doubt expressed by Arthur Balfour whether, judging from his own experience on his estate in Scotland, the conditions in rural areas were such as to conduce to the superiority in physique usually attributed to the countryman over the town population, if such superiority were a fact, and the conclusion, drawn from his observations of hair- and eye-colour, by Dr F. C. Shrubsall, that residence in urban areas favoured the dark as against the fair element in the population, and that this might possibly bear upon the incidence of disease, especially tuberculosis and cancer

The question raised in the discussion by the president of the Association served to emphasise the fact, already made patent in the report of the Inter-Departmental Committee, that there was a paucity of relevant measurement upon which any conclusion as to physique could be based Broadly stated, however, the conclusion of the Inter-Departmental Committee was that there was no evidence of organic, extensive or permanent physical deterioration in the population as a whole.

It was clear that this conclusion rested, for the most part, upon expressions of opinion, well-founded, no doubt, rather than upon the evidence of extended and comparative series of measurements These did not exist, except in so far as afforded by the British Association Committee's reports Other figures brought forward afforded no certain basis of comparison For children and adolescents, it is true, restricted series were available such as the measurements of the boys of Marlborough, where the annual anthropometric reports of Mr E Meyrick were a feature of the Field Club magazine for many years, and of Manchester Grammar School, but little was known of the working-class child-population.

Anthropologists were not slow to point out the defects of the report, and they emphasised the futility of discussion of groups of measurements from specific areas, or social groups, whether of adults or of children, unless a norm, or standard of normal development, or a series of such norms, had been established for the country as a whole and, more especially, for the various racial groups of which the population was composed So far as the measurement of children was concerned, the anthropologists joined forces with the educationists and every effort was made by deputation and otherwise to bring their views to the notice of the Government of the day. Arrangements were made for a joint discussion between the Anthropological and Educational Sections of the British Association to take place at the Leicester meeting in 1907, in which even that distinguished authority on the school child, Prof. J. Munsterberg, was prepared to join But when the meeting took place, its thunders had been stolen. In the course of the debate, Mr. Ramsay Macdonald, the leader of the Labour Party, who had promised to speak in support of a demand for Government action, was able to report that the previous night, or rather in the early hours of that morning, a Bill for the medical inspection of school children had passed its third reading in the House of Commons For the success of this measure Sir Philip Magnus, the educationist, representative in Parliament of the University of London, had been largely responsible

The self-congratulations of the anthropologists on this measure were premature While recognising its value, and well aware of the benefit which, as time has shown, it was to confer on the people, when the Act came into operation, they noted with regret that no provision was made for anthropometric measurement as a general operation, and no attempt was made to set up a racial standard or standards against which to measure the abnormal or under-developed The results may be seen in some of the general conclusions put forward, especially in connexion with the effects of malnutrition, in early reports by medical officers who had not appreciated the finer points, patent to the anthropologist, in handling their material

From this time forward, the project of a nation-wide anthropometric survey, though not sinking entirely into oblivion, became less prominent It merged into larger proposals which the Royal Anthropological Institute contemplated promoting, while the untimely death of John Gray in 1912 and the outbreak of War helped to relegate it still further to the background in which stood the many desirable things which were to await more propitious times

In the meantime, also, active interest in anthropometric research had shifted to the regional surveys which were being carried out by individual workers, singly or in groups, and this up to the present has continued in the post-War period Of these surveys, it is not possible to refer in detail and mention must be confined to one or two, such as that carried out by Prof H J Fleure and his colleagues and pupils in Wales, of which an early report was presented at the Sheffield meeting of the British Association in 1910, the work of Prof F G. Parsons and his helpers in the Chilterns, which he has linked up with wider aspects of British ethnology especially in connexion with skeletal material from London and, more recently, Miss R M Fleming's continuous periodical measurements of school children in Wales, and her study of hybrids

The work carried out by Prof Fleure, or under *his inspiration, is especially important in* connexion with the proposal which has been put forward by the Royal Anthropological Institute Working with Aberystwyth as centre, Prof Fleure and his pupils have demonstrated the relation of racial history to a number of sociological and economic problems Of these investigations, not the least suggestive, from the point of view of practical politics, is the attempt to correlate, on scientific evidence above cavil, racial constitution and the incidence of disease

Apart from its practical applications, to which due weight must be given when public assistance is sought, to the anthropologist the most pregnant feature in Prof Fleure's work has been the demonstration of restricted areas in which has been found what appears to be the survival of a primitive—in some instances an extremely primitive—form among a population essentially modern in character In this his work links up with the more subtle interpretation of the prehistoric skeletal remains which began, perhaps, in the opening years of the century with Prof T H Bryce's survey of the prehistoric population of the short-cist graves of the Isle of Arran and the identification, soon afterwards, of the Beaker type, in the broad-headed skulls found in the neighbourhood of Aberdeen As Prof Fleure has again pointed out recently, the broad generalisations of racial history in Britain, however true at a certain level of thought, may mask rather than reveal facts of which a detailed view is needed In linking up the prehistoric data with those relating to the modern population, the survey which the Royal Anthropological Institute contemplates will carry on methods of study which, as received from the hands of Prof Fleure, have already had a profound effect in their application to racial problems in areas other than Wales

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Obituary

PROF. J. J R. MACLEOD, F.R.S.

BY the death after a long illness, on Saturday, March 16, of J J R Macleod, regius professor of physiology in the University of Aberdeen, medical science has lost an outstanding worker.

John James Rickard Macleod, a son of the manse, was born at Cluny, near Dunkeld, on September 6, 1876. He was educated at Aberdeen Grammar School and at the University of Aberdeen. He completed a distinguished undergraduate career by graduating M B , Ch B with honours in 1898, being awarded at the same time the Anderson Travelling Scholarship He worked for the next year in Germany, in the Institute of Physiology at Leipzig In 1900 he was appointed demonstrator in physiology at the London Hospital Medical College and in 1902 was promoted to be lecturer in biochemistry In 1901 he had been elected to the Mackinnon Scholarship of the Royal Society. He was appointed in 1903 to the chair of physiology at the Western Reserve University, Cleveland, Ohio, where he remained until 1918, when he was elected to the chair of physiology at Toronto. During his later years at Cleveland, he was engaged in various duties arising directly out of the War of 1914–18. He also acted as professor of physiology at McGill University during part of the winter of 1916. After nine years at Toronto, he was appointed in 1928 to the regius professorship of physiology at Aberdeen, a post he was holding at his death.

Macleod's main interest and occupation throughout his academic life was, of course, the metabolism of carbohydrate. He published his first papers on experimental glycosuria in 1905, and between 1907 and 1917 a series of twelve papers under the general title of "Studies in Experimental Glycosuria" were published in the *American Journal of Physiology* as well as a series of eighteen papers between 1908 and 1921 dealing with other aspects of carbohydrate metabolism. Macleod had thus a full knowledge of practically all the phases of this field of metabolism and the intimate parts played in it by the main tissues and organs of the body. Thus equipped, he was both ready and willing in 1921 to put all the facilities of his laboratory and his unique knowledge of the subject at the disposal of the young investigator, F. G. Banting, who came to him with views on the isolation and preparation of the active principle of the internal secretion of the pancreas. The intensive research work which followed, in which two other collaborators deserve honourable mention, J. B. Collip and C. H. Best, culminated, as is well known, in the isolation of the active principle, insulin, from the islet tissue in such a pure form that it could be utilised as a medicament in practice. The original idea which started this particular piece of fundamental research in the Toronto laboratory was certainly Banting's, but, without the facilities and co-operation provided by Macleod and others, it is very doubtful if the investigation would have reached such early fruition. The marvel, indeed, is that such clean-cut and final results were obtained so speedily. The whole story is a testimonial to the value of team work ably directed to a single end.

Macleod's activities in the field of carbohydrate metabolism received a fresh impetus with the discovery of insulin, and most of his later experimental work was directed towards the mode of action of the active principle. His latest experiments were, in a way, a retrogression to the old ideas of Claude Bernard and his diabetic centre. Macleod had taken up the investigation of the nervous control of glycogenesis in the liver and had obtained some interesting and suggestive results.

Although Macleod's interests were centred on carbohydrate metabolism, he had from time to time carried out interesting investigations in other fields. He had published papers either alone, or in collaboration with others, on caisson sickness, the control of breathing, ventilation, the biochemistry of carbamates, phosphorus of muscle and on many other miscellaneous subjects. He published, in addition to several books dealing with insulin and carbohydrate metabolism, an original textbook, characteristic of the man's outlook, "Physiology and Biochemistry in Modern Medicine", which is now in its seventh edition.

In 1923 Macleod, jointly with Banting, was awarded the Nobel Prize in Physiology and Medicine, and in the same year was elected a fellow of the Royal Society. He was a fellow of the Royal Societies of Edinburgh and of Canada and a fellow of the Royal College of Physicians of London. In 1928 he was appointed Vanuxem Lecturer in the University of Princeton and in 1933 Herter Lecturer in Johns Hopkins University. He had been a member of the Medical Research Council (1929–33), past president of the Royal Canadian Institute (1925–26) and of the American Physiological Society (1922–23). He was a member of many learned societies, and held honorary degrees of several American universities as well as the LL.D. of his own Alma Mater.

As a man and a teacher Macleod was beloved by his friends and students alike. He was an excellent lecturer, lucid, happy and attractive. As a supervisor of research no one could have desired a more kindly and stimulating mentor. He was ever willing to listen and to help, no matter how slow the pupil, provided the worker was in earnest. As a man he was always happy, friendly and full of enthusiasm. He met every one with a cheery smile. He was an optimist who refused to be depressed by ill fortune, and during the past four years he required all his optimism and cheeriness of spirit to stand up against his affliction. No one could have faced with greater patience and a braver spirit the handicaps placed upon him.

E. P. C.

PROF. R. O. HERZOG

PROF. R. O. HERZOG, who died at Zurich on February 4, made himself a name by discovering the microcrystalline structure of cellulose. He and Scherrer found it simultaneously and independently, when irradiating different kinds of cellulose fibres with X-rays. This observation gave an enormous impetus to the investigation of fibres and organic substances of high molecular weight: twenty years ago, for example, no one would have dared to write down the structural formula of cellulose or to consider the rigidity of a macromolecule containing oxygen bridges, subjects of lively discussions at many scientific meetings nowadays. Herzog himself, then the head of the newly founded Kaiser Wilhelm Institut fur Faserstoffchemie at Berlin-Dahlem, was most active in promoting this development, and his vivid imagination played from the beginning with ideas which have materialised in recent years. Michael Polanyi, Karl Weissenberg, Hermann Mark, Max Bergmann and Erich Schmid did research in his laboratory at Dahlem, and it was remarkable how successfully Herzog was able to collaborate with younger men.

The behaviour of substances of high molecular weight had always interested Herzog. He was one of the first to determine the diffusion constants of proteins and enzymes, and to become acquainted with the anomalies of the diffusion of dyestuffs, his investigations concerning skin as an adsorbent, in correlation with the process of tanning, also deserve to be mentioned.

As to the technical work done by Herzog, his main efforts were concentrated on the literary side. He compiled a handbook of organic technology, and also edited a very comprehensive handbook series on the technology of textiles.

Herzog's intellect was keen, and his mind extremely versatile It was striking how quickly he discerned the possible answers to a given question; owing perhaps to an artistic trend in his nature, he seemed to prefer a subtle and surprising explanation to simpler and more probable ones, and was sometimes right in doing so

Born at Vienna on May 20, 1878, as the son of an influential journalist, Herzog took his degree at the University of Vienna in 1901 The following years he spent in Germany doing research work and commencing his academic career as *Privatdozent* at Karlsruhe in 1905 In 1912 he became professor of physiological chemistry at the German Technical Highschool in Prague, and from 1919 until 1933 he held the post at Berlin Dahlem referred to above He accepted in 1934 a professorship of chemical engineering at the University of Istanbul

Many friends deeply regret to have lost so prematurely a man of his inspiring personality.

H F

WE regret to announce the following deaths

Dr. Shepherd Dawson, principal lecturer in psychology, logic and ethics in Jordanhill Training College, Glasgow, known for his work on vision and statistical problems in psychology, on March 26

Dr Carl Duisberg, founder and chairman of the I G Farbenindustrie, known for his work in connexion with aniline dyes, on March 18, aged seventy-three years

Prof A Hantzsch, formerly professor of chemistry in the University of Leipzig, who was an honorary fellow of the Chemical Society, on March 14

Sir E Sharpey Schafer, F R S, emeritus professor of physiology in the University of Edinburgh, on March 29, aged eighty-five years

News and Views

Differential Analyser for the University of Manchester

THE important new calculating machine, known as a differential analyser, presented to the University of Manchester by its deputy treasurer, Mr Robert McDougall, and constructed by the Metropolitan-Vickers Electrical Co. Ltd., was opened on March 27 A distinguished gathering, presided over by the Earl of Crawford and Balcarres, Chancellor of the University, heard from Prof. D. R Hartree, under whose direction the machine has been built, an account of how it is constructed and what it will do Briefly, the object of this machine is the evaluation, by mechanical means, of solutions of ordinary differential equations; it is readily applicable to a very wide range of such equations, and in particular is not restricted to those which are linear. The original conception of such a machine was due to Lord Kelvin, and the first satisfactory working machine was designed and built by Dr V. Bush at the Massachusetts Institute of Technology; this machine is quite distinct from one for solving simultaneous algebraical equations, also designed by Dr Bush, of which mention has already been made in NATURE (Dec 8, 1934, p. 877).

PROF. HARTREE mentioned the wide range of problems in pure and applied science to which the differential analyser could be applied, and said that he hoped to see it used, not only for investigations in pure science, such as the problem of atomic structure in which he was particularly interested, but also to work of technical and industrial importance as well. He paid a warm tribute to Mr. McDougall's munificence in furnishing the University with this powerful and important research tool, to Dr Bush for his generous and friendly co-operation in its design, and to various members of the Metropolitan-Vickers Electrical Co Ltd., who had been concerned in its design and construction After brief speeches by Sir Kenneth Lee, who declared the machine 'open for business', Sir Henry Lyons, and Prof Bragg, those present descended to the basement of the Physics Laboratory where the machine has been erected, and saw a demonstration of the machine in operation.

Lord Bledisloe and Maori Studies

AMONG the many public-spirited acts which have marked Lord Bledisloe's tenure of the office of Governor General of New Zealand, few aroused more public enthusiasm than the gift to New Zealand by Lady Bledisloe and himself of the Waitangi Estate, the historic ground where the treaty between the British authorities and the Maoris was signed in 1840 To mark the ninety-fifth anniversary of the signing of the treaty, and to commemorate the gift of this land to the people of New Zealand, the New Zealand Numismatic Society, of which Lord Bledisloe is patron, has struck a medal in silver, bearing the head of Lord Bledisloe on the obverse, which was presented to him at a meeting of the Society held at Wellington on February 6 The presentation was made by the president of the Society, Prof J Rankine Brown In accepting the medal, Lord Bledisloe expressed the hope that the nationalisation of Waitangi would help to promote in New Zealand the sense of nationhood, and referred to the work of the first governors, Capt Hobson and Sir George Grey, "the great far-sighted pro-consul and racial pacificator". Lord Bledisloe went on to emphasise the importance of Polynesian, and particularly Maori, studies He maintained that the white people should learn the language and appreciate to a greater extent the mental and spiritual outlook of the Maori people While he regretted that it is no longer true, as it was thirty years ago, that at least one third of the Legislature is acquainted with the Maori language and outlook, he hoped that improvement would come from the endowment left to promote knowledge of the manners, customs and language of the Polynesians by the late Prof Macmillan Brown, whose enlightened aspirations had given him personally immense encouragement

Recent Archæological Finds in Ireland

AN authoritative article on recent Irish excavations by Mr Sean F. O'Riordan, of the National Museum of Ireland, appears in the April number of *Discovery*. During the year 1934, the National Museum received an unusual number of accessions of exceptional interest as the result of casual discovery Among these were the remarkable gold gorget of about 700 B C from Co Clare, the bronze age wooden shield—only the second known—from Co Mayo, the fine Middle Bronze Age rapier from Co Tipperary and much noteworthy Viking material from Co Dublin The greatest advance in the study of Irish archæology, however, has been due to the participation of archæologists in carrying out the Government's scheme for unemployment This has made possible systematic investigation on an extended scale on an unprecedented number of sites No less than twelve excavations were carried out in various parts of the country, ranging in date of the period under investigation from post-glacial times to the fifteenth century A D The number of workmen engaged on individual sites in these operations varied from twelve on the smallest to fifty on the largest.

The results of the investigation of the sequence of events in post-glacial times at Ballybetagh are already well known, owing to the interest aroused by the pollen analysis, though the report is not yet complete Another investigation of wide general interest, although purely negative in result, is that in the cave of Kilgreany, Co Waterford Some years ago members of the Bristol Spelæological Society claimed to have found there human remains of palæolithic age The present investigation has not substantiated this, and evidence of palæolithic man in Ireland is still to be sought Questions of major interest are also solved at Cush, near Kilfinane, Co Limerick, where for the first time ring forts were found in a series of six, a souterrain was for the first time definitely dated so early as pre-Late Bronze Age, and the Irish town, previously not known before Viking times, was shown to have existed so far back as the Bronze Age

Major-General A. W. Greely

THE American explorer Major-General A. W. Greely, who has just reached the age of ninety-one years, is reported by *The Times* to have been awarded the Congressional Medal of Honour of the United States for heroism on his Arctic expedition of 1881–84. That expedition was the contribution of the United States to the International Polar Stations of 1882–83 Under Lieut Greely's leadership, three officers and nineteen men were landed in Discovery Harbour in Grant Land (Ellesmere Island). The main objects were meteorological and magnetical observations, but Lieuts Greely and Lockwood carried out extensive explorations in Grant and Grinnell Lands, and Lieut Lockwood made the northern record to lat 83° 24′ N The relief ship was prevented by ice from reaching the camp in 1882 and again in 1883 Lieut Greely then decided to retreat to the south with much depleted equipment and scanty stores Near Cape Sabine in Smith Sound, they passed their third winter Already scurvy had taken a heavy toll and the remaining men were scarcely able to hunt, fuel and food were practically exhausted when in June 1884 relief reached them in the *Thetis* Only seven men were alive, not one could walk without assistance and at the time there seemed little likelihood of any living long enough to reach an American port General Greely was awarded the Founder's Medal of the Royal Geographical Society in 1886 for the excellence of his Arctic work

Henry Fuseli (1741–1825)

A RENEWED interest in the work of the Swiss artist Henry Fuseli (1741–1825) is being taken at present through an exhibition of some of his paintings and drawings at Ryder Street, London, S W 1 Fuseli came to London at a time when Germany was anxious to establish channels of literary communication with England Among those whose acquaintance he cultivated was Johnson, the radical bookseller of St Paul's churchyard, where Priestley usually stayed when he came from the provinces to the metropolis Both Fuseli and Priestley were in holy orders occupied occasionally with pamphleteering and possessing considerable linguistic abilities In Thorpe's "History of Chemistry" is a portrait of Priestley delineated by Fuseli in which the discoverer of oxygen is depicted with more femininity of expression than is usually associated with such a free lance Fuseli became one of the 'lions' of London society and an indispensable guest at many a fashionable dinner table He was buried in St Paul's Cathedral between the graves of Opie and Reynolds

Professor of Astronomy at the Royal Institution

AT the general monthly meeting of the members of the Royal Institution, held on April 1, it was resolved to establish a professorship of astronomy Sir James Jeans was nominated, and in the event of his election at the ballot on May 7, will become the first professor of astronomy in the Institution. The last occasion when a new chair was created was the year 1863. This was for Dr. (afterwards Sir Edward) Frankland, who was elected to a separate professorship of chemistry while Faraday was still the Fullerian professor of chemistry. Frankland's professorship lapsed, however, after Faraday's death. The other 'elected' professorship in the Institution at the time, that of natural philosophy, had been established ten years earlier, and was not so short lived. It was created for Tyndall when he went to the Institution in 1853, and since his retirement in 1887 has continued by election and re-election down to the present day. Sir James Jeans has thus been nominated to the first new professorship to be established in the Royal Institution for some seventy years. It is also the first chair of astronomy in the history of the Institution.

Revision of Ordnance Survey Maps

DURING last autumn, the council of the Chartered Surveyors' Institution decided to press for an official inquiry into the present position of the maps and plans of the Ordnance Survey, and an article on the subject appeared in NATURE of November 3 (p. 677). In reply to a question by Sir Francis Fremantle in the House of Commons on April 1, Mr Walter Elliot, Minister of Agriculture, said: "A substantial addition has been made to the Ordnance Survey Estimates for 1935, and this will enable a beginning to be made in the way of overtaking arrears. I propose, however, to refer to a Departmental Committee the whole question of the acceleration of the revision of Ordnance Survey maps and the preparation of plans for town and country planning. I hope shortly to be able to announce the composition of the committee and its terms of reference."

Model of the *Rocket*

A FULL SIZE replica of the locomotive *Rocket*, as originally designed and constructed by Robert and George Stephenson, has now been acquired for the National Collections in the Science Museum, and will be unveiled by Mr L. Hore-Belisha, Minister of Transport, at noon on April 11. The model has been made by Messrs Robert Stephenson and Co., the firm which built the original engine, and represents it, as nearly as possible, in form, materials and workmanship, as it originally appeared. The original engine was built to compete at the Rainhill Trials in October 1829, which was perhaps the most important event in early locomotive history. The success of Stephenson and Booth's *Rocket*, which won the premium of £500 offered by the directors of the Liverpool and Manchester Railway for the most improved locomotive engine constructed in accordance with certain conditions, definitely proved the suitability of the locomotive as a means of general railway haulage, and showed that speeds hitherto unapproached could be attained. The engine was entered by George and Robert Stephenson and Henry Booth. Its success was mainly due to the adoption of the tubular boiler, which was suggested to George Stephenson by Booth. While George Stephenson is popularly credited with the design of the *Rocket*, its actual construction, at Newcastle, was carried out by his son Robert, the father's time being fully occupied with the making of the railway itself.

Co-operation between the Chemical Societies of Great Britain

THERE has recently been circulated to all members of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry a draft agreement between the three Societies in regard to co-operation. The adoption of the agreement is unanimously recommended by the Council of the Society of Chemical Industry and the draft agreement was published in *Chemistry and Industry* on March 15. The agreement provides for the establishment of a fund to be administered by a Chemical Council consisting of three members nominated by the Council of each Society, together with three representatives of industry, co-opted in the first instance on the nomination of the Association of British Chemical Manufacturers. The objects of the fund are the allocation of grants to the constituent bodies for the co-ordination of scientific publications, promotion of research, maintenance of a library, etc. Complete freedom of action is reserved to each constituent body in respect of the matter it publishes. The management of the library of the Chemical Society is delegated to a joint library committee, and contributions to the net annual maintenance expenditure are to be borne by the constituent bodies in proportion to their membership, with due allowance for overlap. This involves, for example, an increase in the contribution of the Institute of Chemistry to £654 and from the Society of Chemical Industry to £448. The agreement is for seven years and there after to continue for successive periods of three years, subject to right of withdrawal on giving one year's notice at the end of any period. If the agreement succeeds, it is anticipated that means of reducing subscriptions to the three organisations will be found.

American Chemical Industry

THE American Chemical Society is holding in conjunction with its annual meeting in New York on April 22, what may prove to be the largest scientific assembly in history. The object is to expound and commemorate the development of the American chemical industry since its foundation three hundred years ago by John Winthrop Jr., son of the pilgrim Governor of the Massachusetts Colony. In 1633 he set up in Boston the first chemical laboratory and library in the United States, for which he imported apparatus, chemicals and chemical books, and two years later when he became the first colonial Governor of Connecticut, he mapped out a far-reaching programme of local industries including the production of salt, iron, potash, tar, black lead, saltpetre, medicines, copper, alum and other chemicals. Some of these chemicals were made for local use; the chemicals of the forest were exported. It was at Winthrop's suggestion that Massachusetts passed a law in 1642 requiring every town to collect manures to make saltpetre. Chemical industry in the modern sense did not begin in the United States until 150 years later, when in 1792 the manufacture of sulphuric acid was commenced in Philadelphia by John Harrison.

SINCE that time, the American chemical industry has not ceased to expand. In 1913–14 it produced 34 per cent by value—and much more by weight—of the world's chemical output; in 1923–24 this percentage had risen to 47 per cent. At the Congress it will be shown how the infant industries have become the bulwark of national defence, the basis of modern industrial progress and the source of an ever growing percentage of national wealth. The honorary chairman of the New York Committee is Mr. Francis P. Garvan; the presidents of the great chemical companies are co-operating with the Society. At the chief symposium the outstanding addresses will be by T. Midgley on "Chemical Developments in the next 100 years", and W. B. Bell on "National Planning and the Chemical Industries". In addition, Senator Harrison will discuss economic aspects of the chemical industries in general. Mr. Lammot du Pont will deal with chemistry's sociological results and Senator Wadsworth will consider its importance in national integrity. The Congress will be divided into eighteen divisions ranging from foods to petroleum.

Hydrogenation of Coal

A LECTURE by Dr. Pier before the Technische literarische Gesellschaft, Berlin, on the hydrogenation of coal, possesses an unusual importance in view of present interest in this subject and also in German efforts at national self-sufficiency. In Germany the first technical success was achieved in the hydrogenation of brown coal and tars produced therefrom. For several years large quantities of petrol have been produced from brown coal at the Leuna works of the I. G. Farbenindustrie A.G. Since 1932, interest has been directed to corresponding treatment of bituminous coal in the Ludwigshafen works of the I.G. Since last year, a plant capable of a daily throughput of 20 tons of coal has been working there, and it is the successful performance of this unit which forms the subject of Dr. Pier's paper. Actually, a somewhat similar plant has been in operation at the Billingham works of Imperial Chemical Industries, Ltd. since 1930, and the large unit (500 tons daily) projected in 1933 will soon be brought into commission. The results of the German tests leave no doubts as to its success.

HYDROGENATION reactions may take several forms, for example, in liquid phase with coal or oil, and in vapour phase with more volatile liquids. At Billingham the petrol is already being made from creosote oils in vapour phase units. The patent rights in these processes are held by the International Hydrogenation Patent Co., and since 1931 experience and information in these processes have been pooled by the I.G., Imperial Chemical Industries, Standard Oil and Shell Oil Companies. Although the literature of coal hydrogenation on the experimental scale is large, information about the construction and performance of manufacturing units has not hitherto been disclosed, and this lends added importance to Dr. Pier's paper. As a result of international co-operation for scientific and industrial purposes, the work stands in marked contrast to corresponding efforts in the political fields.

Excavation of Norfolk 'Woodhenge'

ACCORDING to an announcement reported in *The Times* of March 29, preparations are being made by the Norfolk Research Committee, of which Mr. Russell J. Colman is president, to explore the site which, from its similarity to that on Salisbury Plain, has been called 'Woodhenge', at Arminghall, near Lakenham Baths, Norwich. The existence of this circle was first ascertained by observation from the air by the Royal Air Force, and certain preliminary examinations carried out soon after revealed the character of the site; but no systematic or extended excavation has as yet been attempted. The present operations will be under the supervision of Dr. Grahame Clark, of Peterhouse, Cambridge, and secretary of the Fenland Exploration Committee, and Mr. Rainbird Clark, honorary secretary of the Norfolk Research Committee. The work will begin in August next and, it is hoped, will be completed when the British Association meets at Norwich in the following month.

Jubilee of the Dublin Naturalists' Field Club

THE jubilee of the Dublin Naturalists' Field Club will be celebrated in Dublin on July 11–13 by a meeting of representative delegates from many of the natural history societies in Ireland and Great Britain, and probably from abroad. Formed fifty years ago with Prof. E. Perceval Wright as its first president, the man mostly responsible for the initiation of the Dublin Naturalists' Field Club was its vice-president, Dr. A. C. Haddon, the veteran anthropologist now at Cambridge. The formation of the Irish Field Club in 1894 brought the Society into closer touch with other natural history bodies in Ireland, while in 1892 it was largely responsible for forming the old *Irish Naturalist* as a monthly journal for the scientific recording of its and other societies' proceedings. Among the more notable workers of the Field Club in its history were G. H. Carpenter the entomologist and mammalogist, for many years its president, as at the Galway Field Club conference of 1895; Dr. R. Lloyd Praeger, its secretary in late Victorian times, who wrote the flora section of the British Association Handbook for its Dublin meeting of 1908; and David McArdle, of Glasnevin, who wrote the section on mosses and lichens in the same handbook. Other prominent members of the Field Club in its early years were Prof. T. Johnson, its treasurer, Prof. E. J. M. M'Weeney of Dublin and Prof. G. F. Fitzgerald of Trinity College.

Twelfth International Congress of Zoology

IT is announced that the Twelfth International Congress of Zoology will be held at Lisbon on September 15–21 under the presidency of Prof. A. Ricardo Jorge, professor in the Faculty of Sciences in the University of Lisbon, and director of the Zoological and Anthropological Department of the National

Museum of Natural History (Museum Bocage) His Excellency the President of the Portuguese Republic has consented to become Patron of the Congress, and the Portuguese Government has invited foreign countries to be represented by official delegates It has been provisionally arranged that the work of the Congress will be carried on in twelve sections, dealing respectively with (1) general zoology (including cytology and genetics), (2) embryology and the mechanics of development, (3) comparative anatomy, (4) physiology, (5) zoogeography and palæozoology (including ecology), (6) protozoology, (7) entomology, (8) invertebrates, (9) vertebrates, (10) parasitology, (11) applied zoology, (12) nomenclature Some of these sections may be subdivided if the need arises Among social events proposed are receptions by the President of the Republic, by other Ministers, by the Rector of the University, and by the municipality of Lisbon; and various excursions, including one to Madeira and the Azores to take place after the Congress, are contemplated. Special facilities as regards railway fares and hotel rates are being arranged for by the organising committee Zoologists desiring to take part in the Congress are requested to communicate with the president, Prof Arthur Ricardo Jorge, Director, Zoological and Anthropological Department, National Museum of Natural History, Lisbon, Portugal, from whom particulars can be obtained

The Strangeways Laboratory

THE Strangeways Research Laboratory was founded by the late Dr Strangeways in Cambridge twenty-one years ago A recent report by the trustees and director takes the opportunity of recalling the history of its foundation and development during this period, in addition to giving the usual account of the past year's work The building now used as the laboratory was originally equipped as a small hospital for the treatment and study of chronic arthritis, but Dr Strangeways soon became convinced that a more complete and fundamental knowledge of the processes of normal growth was an essential condition for real progress in the investigation of this and other diseased conditions The hospital therefore became a group of experimental laboratories devoted to the study of growth problems by the methods of artificial culture of tissues Dr Strangeways died in 1926 his principal collaborator, Dr Honor Fell, has acted as director since 1928 Since 1931, the Royal Society has made itself responsible for the director's stipend, by a fellowship from its Messel Research Fund. The Medical Research Council has made grants providing for the support of certain members of the staff and for general expenses of the work Grants have been made by the British Empire Cancer Campaign, by the Fitton Trust and by the Sir Halley Stewart Trust; and the laboratory has received voluntary subscriptions and donations, though both of these sources of income have varied widely from year to year. To enable the work of the laboratory to continue and to expand, an increase in the annual income is, however, required. During the past twenty one years, 84 persons have worked in the laboratory and 81 papers have been published. The research work of the laboratory is devoted to fundamental problems of normal and abnormal growth and the effects of different forms of radiation upon living cells, problems of immense importance to the successful treatment of tumours in human beings by X-ray and radium

A New Rotating Radio Beacon

A ROTATING loop type of radio beacon was developed in Great Britain several years ago, and two stations employing this arrangement are still in use in connexion with aerial and marine navigation The advantage of the system is that wireless bearings may be obtained at any receiving station merely with the aid of a stop watch or chronometer The use of such a chronometer is rendered unnecessary in a new type of rotating beacon, which is described in a paper by U Okada, published in the report of Radio Research in Japan of October 1934, vol 4, p 185 In this new system, a vertical loop transmitting aerial is used as previously, to give the usual 'figure of eight' radiation characteristic Instead of rotating this loop continuously, however, it is swung backwards and forwards about a vertical axis through an arc of 180°. During its movement the speed of rotation is uniform and equal to one revolution per minute The movement in each direction starts from a north and south position alternately, at each of which a characteristic morse signal is emitted This signal is then followed during the rotation of the loop by a succession of 90 dots, at the rate of 1 dot for every 2 By counting the number of dots from the starting point to the signal minimum, the bearing of the receiver from the transmitter may be calculated The additional observation taken with the loop moving in the reverse direction enables the midpoint of a broad minimum to be accurately determined Tests carried out in Japan on land and at sea have shown that an accuracy of observation of ±6° was obtained at distances up to 46 km with an experimental beacon operating on a wave length of 950 m It is considered that by attention to details of the apparatus the maximum error could be reduced to 2°, which it is suggested is sufficient for most practical purposes

The 100-in. Mirror Aluminised

ACCORDING to Science Service, of Washington, D C, the 100-in mirror of the great telescope at Mount Wilson Observatory, Pasadena, California, has been aluminised It will be remembered that a new process has been developed within the past two or three years, by which coats of aluminium are placed upon glass mirrors by distillation *in vacuo* (NATURE, **134**, 522, 1934) The aluminium coat presents several advantages over the usual silver coat, chemically deposited The aluminium coat is far more durable and resistant to tarnish, and possesses a superior reflectivity in the ultra-violet Many small mirrors have been successfully coated with aluminium in Great Britain It is expected that the new 200-in mirror will also receive an aluminium coat The aluminium surface on the 100-in mirror is said to be perfect except for the silhouette of a moth in one corner of the large surface

Control of the Bed-Bug

AT the request of the Ministry of Health, the Medical Research Council has undertaken to promote further investigations into the health problem caused by the infestation of houses by the bed-bug, and has appointed the following special committee to advise and assist in this work . Prof. J. C G Ledingham (chairman), Prof. P A Buxton, Mr. C S Elton, Mr C R Kerwood, Dr John Macmillan, Dr G W. Monier-Williams, Prof J W Munro, Dr. P G Stock, Dr R E Stradling, Mr A W McKenny Hughes (secretary), British Museum (Natural History) On the recommendation of this Committee, grants have been made by the Council for research under the direction of Prof Buxton into the natural history of the bed-bug with reference to the conditions of its viability, and for research under the direction of Prof Munro into chemical methods for its destruction.

Announcements

THE Rev Canon Harold Anson, Master of the Temple, and Prof F R Fraser, director of the Department of Medicine in the British Post Graduate Medical School, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

AT the annual general meeting of the Chemical Society held on March 28, the following officers were elected *President*, Dr N V Sidgwick, *Vice-Presidents, who have filled the office of President*, Prof G T Morgan and Prof. J F Thorpe; *Ordinary Members of Council (Town)*, Prof J W. Cook, Prof G. I Finch and Dr J J. Fox , *(Country)*, Mr. W. A. S. Calder, Prof T P Hilditch, Dr F G Mann, and Prof. J. Read

Mr H. L BROOK arrived at Lympne on March 31, on his return flight from Australia in the Miles Falcon cabin aeroplane which he had entered for the Melbourne air race, 7 days 19 hours 50 min. after leaving Darwin. Thus he has set up a new record for a solo flight, being 1 day 2 hours 35 min. better than the record established by Mr J. A. Mollison in 1931, and 13 hours 10 min. better than the unofficial solo 'record' set up by Mr C. J. Melrose in 1934. The aeroplane was a low-wing monoplane with a Gipsy Major (130 horse-power) engine.

A CONFERENCE to discuss current theories as to the cause of swarming of bees and the practical means of controlling it, is to be held on Saturday, April 27, at the Rothamsted Experimental Station, Harpenden, Herts. During the morning the laboratories of the Experimental Station will be open for inspection; it will also be possible to visit the apiary and to see the work which is being done by Dr Tarr under the Foul Brood Research Scheme Those wishing to attend should notify the Secretary of the Experimental Station not later than Wednesday, April 24

THE next congress of the International Vegetarian Union will be held in Zurich in the middle of July, when papers on eugenics and eubiotics will be read Further information can be obtained from M Henri Hotz, 7 Orenstrasse, Zurich

THE executive committee of the German Society of Men of Science and Physicians has decided to hold its ninety-fourth annual congress on May 24, 1936, as the meeting cannot be held this year The president will be Prof Sauerbruch, with Profs Grote and Zaunich as local presidents.

A CONGRESS of the history of Greek medicine will be held at Athens on May 8–11. It will consist of three sections dealing respectively with scientific work, hygienic organisation and professional matters. Further information can be obtained from the professor of the history of medicine, Prof Dr Kounis, Ecole de médecine, Athens.

DURING its eleventh year, the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation has made twenty-seven grants, fourteen of these being to scientific workers outside the United States Further grants will be made during 1935–36 At present, work will be favoured which is directed towards the solution of problems in medicine and surgery. Application must be made before May 1 Further information can be obtained from Dr. Joseph C Aub, Collis P Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Mass

THE Council of the Royal Statistical Society offers the Frances Wood Memorial Prize, value £30, for competition in 1935 The Prize is offered for the best investigation, on statistical lines, of any problem affecting the economic or social conditions of the people Theses submitted or intended to be submitted as university exercises, and also published papers, are admissible. Essays, which must be either printed or typed, and accompanied by copies of all statistical tabulations, must be sent to the Honorary Secretaries of the Royal Statistical Society, 9 Adelphi Terrace, W C 2, not later than October 31, 1935

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A civilian educational officer in the Royal Air Force Educational Service—The Secretary (A E.), Air Ministry, Adastral House, Kingsway, London, W.C 2 (April 17). A principal lecturer and master of method in science at the Glasgow Training Centre—The Executive Officer, 140 Princes Street, Edinburgh, 2 (April 18). A principal of the Midland Agricultural College, Sutton Bonington, Loughborough—The chairman of the Governors, County Education Office, St. Mary's Gate, Derby (April 29). An engineer and surveyor of the City of Westminster—The Town Clerk, City Hall, Westminster (May 18).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 549.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Masses of some Light Atoms determined by a New Method

IT has long been realised that the only really certain method of comparing masses by observations on mass spectra is by resolving and measuring naturally occurring doublets which represent small residual differences between the atoms and molecules concerned The recent discovery of deuterium has enabled this method to be applied generally to the lighter elements, and for some time past I have been constructing parts of a new mass spectrograph designed for this work One of these, a new collimator with variable slits, has been tested on the instrument now in use, with results of great interest

The first test object used in the experiments was the easily formed doublet O,CH_4 Under the improved conditions, this was widely and perfectly resolved, and when measured corresponded to a difference of mass as stated below. This result was very disturbing, as the much lower original estimate 0·0350 had been confidently used as a check on the value for H. On examination, it seems now fairly clear that the underestimate was due to imperfect resolution.

The fineness of the lines warranted an attempt on the doublet D,H_2, expected to be about half the width Pure deuterium was introduced and the discharge manipulated in the hope of getting that equal intensity of the lines so necessary in this work. In a number of cases this object was attained and Fig. 1 shows a photometer graph of one of the exceedingly fine doublets photographed

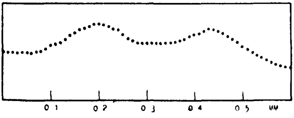

FIG. 1

The apparent separation was estimated as below. The real separation will be probably higher, for the resolution is not yet perfect, but it seems impossible for it to be high enough to correspond to the difference 0·00187 expected from Bainbridge's determinations[1] of H and D each against the same atom He. It seems probable that the bulk of this discrepancy is to be ascribed to the ratio H,He, in which the lines were very unequal in intensity, rather than to that of D,He, in which the conditions were exceptionally favourable. To test that conclusion, I have made a provisional estimate of the wide doublet He,D_2, which within my experimental error agrees with that found by Bainbridge. That his and my estimates of the He,H ratio should have agreed so exactly seems to have been fortuitous

The remaining link in the chain from H to O is the doublet C^{++},D_3 I have succeeded in photographing this, but only with lines of very different intensity and, like the He,D_2 doublet, it is too wide for really satisfactory treatment on my present apparatus The results appear in the following table of doublets, giving the proportional differences in parts per 10,000 and the differences of mass on the atomic scale between the lighter and heavier components

Doublet	Difference of Packing Fraction	Difference of Mass
D,H_2	7·1	0·00142
He,D_2	63·5	0·02550
C^{++},D_3	69·7	0·04195
O,CH_4	23·3	0·0374

I propose to measure all these doublets again with the proper refinements when my apparatus of higher dispersion is completed In the meantime, the following values may be deduced for the masses relative to O^{16}

H = 1·0081
D = 2·0148
He = 4·0041
C = 12·0048

These must be regarded as provisional, and in no case is an accuracy greater than 1 in 10,000 claimed They are considerably higher than my earlier ones and in better accord with the much more delicate but less direct calculations made from the energy relations in the equations of artificial disintegrations. At the meeting of the Royal Society on March 14 attention was directed by Dr M L Oliphant to the discrepancies on the mass scale revealed by experiments of this kind and a provisional scale of values suggested.

I should like to give a word of warning to those using atomic masses determined by mass spectra These figures may depend on a chain of relationships, and it is often found that the errors here have markedly cumulative effects. It will be well always to examine the complete data from which a single result has been derived The results described in this letter are a good example of the dangers in this work In conclusion, I may say that I am never likely to regret my underestimate of the mass of H made nine years ago, however serious it may ultimately turn out to be, since it played so fundamental a part in encouraging the search for deuterium

F. W. ASTON.

Cavendish Laboratory,
Cambridge
March 26.

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[1] *Phys Rev*, **43**, 103, 1933 **44**, 57, 1933.

New Ion Sources for Mass Spectroscopy

FOR use in connexion with a new mass-spectrograph, I have recently developed a new type of ion source in which positively charged atoms are formed by sparks between solid electrodes in a high vacuum. Spectroscopic studies in recent years have shown that these vacuum sparks are efficient sources of multiply charged ions. Several forms of sparks were tried, the '*trembleur à vide*', the 'hot-sparks' from a large condenser discharge, and finally a spark coupled inductively to a high-frequency oscillating spark circuit. This latter has proved very successful, and an abundance of ions has been obtained, thus far from the following elements: platinum, gold, tungsten, tin, copper, nickel, iron, aluminium, carbon, beryllium and lithium.

The ions were analysed provisionally by the Thomson parabola method after being accelerated by about 20,000 volts. The presence of multiply charged ions is in most cases very striking; spots occur with fractional electrostatic deflections, indicating ions that changed their charge before reaching the electric and magnetic fields. With platinum, for example, ions with all charges up to five occur, and with gold all charges up to four. It is of interest that ions of gold and platinum, which have not been found with other methods, are very easily obtained with these sparks.

A. J. DEMPSTER.

Ryerson Laboratory,
University of Chicago.
March 4.

Interferometer Measurements of the Red Auroral Line 6300

WE know that considerable interest is attached to certain auroral lines in the region 6300–6400 A. Thus the enhancement of one or more of these lines is responsible for a particular type of red-coloured auroræ[1,2] and, according to the interpretation of the strong green line by McLennan and his collaborators, the OI triplet ($^1D_2 - {^3P_{0,1,2}}$) should appear in this region.

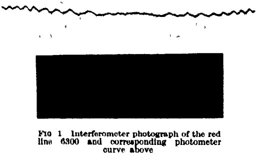

FIG. 1. Interferometer photograph of the red line 6300 and corresponding photometer curve above.

Previous auroral spectrograms taken with instruments of fairly high dispersion have shown two lines, which within the limit of error coincide with the two strongest components of the OI-triplet[3,5], and a faint line has been observed which might be identified with the weakest line of the OI-triplet.

The mean of our present measurements gives λ = 6300·9 (± 1) for the strongest line ($^1D_2 - {^3P_2}$) and λ = 6365·3 (± 2) for the weaker one, which might correspond to ($^1D_2 - {^3P_1}$)[3,5]. Spectrograms in the red[4,5] indicate that bands belonging to the first positive group appear in the region of the OI-triplet.

Some years ago investigations were commenced at the Tromsö Observatory with the object of using interferometer methods for accurate wave-length determinations within the auroral spectrum. Our results relating to the strong green line were dealt with in a recent publication[6], and we are here going to give a preliminary, brief account of some results which refer to the strongest red line 6300.

Just as in the case of the green line we take advantage of the predominance of this red line, so we can use an interferometer without spectrograph, simply consisting of a Fabry-Pérot quartz plate in front of a camera lens combined with suitable filters and photographic plates. Under these conditions only atomic lines and not the fairly strong bands of the first positive group of N_2 can give interference fringes.

During an auroral display (January 15, 1934) an interferometer picture of the strong red line was obtained at the Tromsö Observatory with a 2·5 mm. étalon. The microphotometer curve reproduced in Fig. 1 corresponding to a line through the centre shows that the fringe system is weak, but sufficiently distinct to be measured.

On the same plate were taken two interference pictures of the neon line (λ_{vac} = 5854·110 A.) in the way and for the purpose described in our previous paper[6]. Comparing the diameters of the rings of the interference picture produced by the aurora with those produced by the Ne line 5854·110, we may decide that the interference pattern produced by the auroræ must be due to a fairly sharp atomic line situated near 6300 A., and only the strongest red line 6300·9 A. measured on our spectrograms can come into consideration.

The possible error of our spectrographic measurements of the red line, being about ± 1 A., interference pictures with one (2·5 mm.) étalon does not permit us to make an unambiguous determination of the order number n of the rings on the interference pattern. In the interval of uncertainty there are six order numbers which are possible, giving the following values for the wave length:

Interference order = n + 0·536

n = 12500 +	λ = 6300 +
− 2	+ 1·859
− 1	+ 1·347
0	+ 0·835
1	+ 0·322
+ 2	− 0·190
+ 3	− 0·702

One of our values, λ = 6300·322, is nearly equal to that (6300·328) derived from the electronic OI states given by Hopfield[7]. From direct measurements of the red line with a glass spectrograph (dispersion 29 A./mm.) Hopfield finds the wave-length 6300·23. As the determination of the electronic levels is based on spectra taken with a dispersion of 1·7 A./mm., the wave-length derived from these levels should be most accurate, and this wave-length is, within the limit of error, equal to one of our values for the wave-length of the red auroral line.

In order to fix exactly the true wave-length, we intend to take more interference pictures with étalons of different thickness. Further, by continued observations, we hope to diminish the possible error of our spectrographic measurements.

L. HARANG

Auroral Observatory, Tromsö

L. VEGARD

Physical Institute, Oslo

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[1] L. Vegard, NATURE, **117**, 356; 1926.
[2] L. Vegard, *Geophys. Publ.*, **9**, No. 11; 1932.
[3] L. Vegard, *Z. Phys.*, **75**, 30; 1932.
[4] L. Vegard, *Geophys. Publ.*, **10**, No. 4; 1933.
[5] L. Vegard and L. Harang, *Geophys. Publ.*, **10**, No. 5; 1933.
[6] L. Vegard and L. Harang, *Geophys. Publ.*, **11**, No. 1; 1934.
[7] J. J. Hopfield, *Phys. Rev.*, **37**, 160; 1931.

Isotope Effect in Band Spectra of Hydrides and Deutrides

THE comparison between the band spectra of hydrides and deutrides has shown, as is well known, that the ratio ρ^2 of the reduced masses, for example

$$\rho^2 = \frac{\mu_{AgH}}{\mu_{AgD}}$$

(where $\mu_{AgH} = Mm_H/(M + m_H)$, $\mu_{AgD} = Mm_D/(M + m_D)$, m_H = mass of the proton, m_D = that of the deuton), calculated in this way, does not agree with the ratio ρ^2 as deduced from the atomic weights. As a possible explanation, E. Hulthén and W. Holst[1] have suggested that the electronic system takes part in the rotation and vibration of the molecule and gives a contribution to the effective moment of *inertia*.

A theoretical discussion may perhaps be interesting. If the hydride (deutride) contains an atom with high atomic number, we can assume the distribution of electrons to be spherically symmetrical and start from the distribution of the corresponding negative ion. A suitable expression for the electronic density is that given by H. Jensen[2]

$$D = \frac{N}{4\pi P_0 r_0^3} \cdot \frac{e^{-X}}{X^3}(1 + cX)^2; \quad X = \sqrt{\frac{r}{r_0}}, \quad r_0 = \frac{a_H}{Z^{\frac{1}{3}} \lambda},$$

Z = atomic number, N = number of electrons, $a_H = h^2/4\pi^2 m_e e^2$, where m_e = mass of the electron. P_0 is to be determined by $\int_0^\infty D 4\pi r^2 dr = N$, λ and c are constants corresponding to $1/\lambda$ and c in the table of Jensen[2], and to μ and k in the table of Nagy[3]. Calculating the moment of inertia, we get:

$$I_e = m_e a_H^2 \times Z^{\frac{1}{3}} \times 7\cdot96 \times f\left(\frac{N - Z}{Z}\right)$$

where $f\left(\frac{N-Z}{Z}\right)$, depending on λ and c, is a function of $\left(\frac{N-Z}{Z}\right)$ only. If $\left|\frac{N-Z}{Z}\right| < \frac{1}{10}$, which is certain in our case, we can write:

$$f\left(\frac{N-Z}{Z}\right) = 1 + 3\cdot84\left(\frac{N-Z}{Z}\right) + 9\cdot4\left(\frac{N-Z}{Z}\right)^2$$

An opportunity for comparison with experimental results is given by the careful investigations[4] of E. Hulthén and E. Knave on silver hydride and silver deutride. In this case the total angular momentum of the electrons is 0, and the corrections of Kronig and Van Vleck, being proportional to its square, also equal 0. So we obtain a lower and an upper limit for the ratio ρ^2, taken from the rotational structure of the band spectra AgH and AgD, ρ^2 min $= \frac{\mu_{AgH}}{\mu_{AgD}} = 0\cdot50497$, and ρ^2 max $= \frac{\mu_{AgH} + I_e/a^2}{\mu_{AgD} + I_e/a^2} = 0\cdot50545$ (a = nuclear distance). ρ^2 max is obtained if all the electrons take part in the rotation.

E. Hulthén and Knave have found $\rho^2 = 0\cdot50527$ from the B-values. Thus the correction is 60 per cent of the theoretical maximum. Using the electronic density D mentioned above, the calculation shows that this correction will be obtained, provided the four outermost electrons take part in the rotation. This is the same as saying that the electrons outside a sphere with radius 1·7 a_H are constrained by the hydrogen nucleus to take part in the rotation.

We may verify the reliability of the expression D for the electronic density by calculating the nuclear distance of AgH to the first approximation. Starting from the charge distribution D of the negative silver ion, we determine the distance from the Ag nucleus at which a positive particle can be in equilibrium. The result, 2·78 a_H, is in good agreement with the experimental value[5] 3·05 a_H and indicates that the moment of inertia will be somewhat greater than our I_e, if the effect of the hydrogen nucleus on the electronic distribution is taken into account.

I am obliged to Prof. E. Hulthén, who directed my attention to this question, and to Prof. O. Klein, for interesting discussions on the subject.

LAMEK HULTHÉN

Institutet for mekanik
och matematisk fysik,
Stockholms Högskola.
Feb. 12.

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[1] Holst and Hulthén, NATURE, **133**, 496, 796; 1934. *Z. Phys.*, **90**, 712; 1934.
[2] Jensen, *Z. Phys.*, **77**, 722; 1932.
[3] Nagy, *ibid.*, **91**, 105; 1934.
[4] E. Hulthén and E. Knave, *Physica*, in press. I am indebted to the authors for being informed of the results before publication.
[5] E. Knave, "Dissertation", Stockholm, 1932.

Internal Recombination during Photo-dissociation of Polyatomic Molecules

IT has been generally admitted that, in the primary decomposition of a molecule by absorption of light, free atoms or unsaturated radicals are produced. In an extensive investigation upon the photo decomposition of carbonyl compounds, Dr. R. G. W. Norrish and his co-workers[1] have advanced the view that an aldehyde molecule can be disrupted into a saturated hydrocarbon and a carbon monoxide molecule in one process. This is equivalent to a recombination of the liberated hydrogen atom and alkyl radical at the moment they leave the remainder of the molecule.

The possibility of such a process can be tested directly if the magnitude of the absorbed quantum is large enough to produce excited atoms, or radicals which will recombine to form an *excited* molecule emitting its characteristic spectrum. By observing this emission under conditions which prevent the possibility of secondary processes, that is, at very low gas pressures, we should get definite proof of the existence of such an internal recombination.

An investigation in this direction has been undertaken in this laboratory. Polyatomic molecules containing halogen atoms instead of alkyl radicals, or hydrogen atoms, are better suited for the purpose because the excited halogen molecule liberated during the photo-dissociation process can be easily detected by its emission spectrum, which lies in the visible region. We tried several molecules of the composition $XHal_4$, and $XHal_2$, where X is C or Sn and Hal is a halogen After some unsuccessful attempts, we obtained in SnI_4 vapour under the action of wave-lengths in the range 2500–2150 A a bright visible emission of the spectrum of I_2 with an abnormal distribution of intensity in the bands A detailed investigation confirmed the conclusion which immediately followed from this fact, namely, that the iodine molecule was detached from the SnI_4 molecule in one primary process As the iodine atoms were originally bound to the central Sn atom by valency forces and did not markedly interact one with another, the whole process is equivalent to a recombination of atoms in the very act of photo dissociation, or to a redistribution of valency bonds The energy balance, the influence of collisions with other molecules and other features of the emission so far studied lead to interesting conclusions about the mechanism of the disruption The most important peculiarity is a marked temperature coefficient which indicates the necessity for an energy of activation for this type of photo dissociation

In this connexion we have re-investigated the yellow fluorescence in BiI_3 vapour, observed in this laboratory some years ago[2] Although the spectrum of this fluorescence on closer examination did not reveal any band structure, nevertheless the exact coincidence of its position with that of the iodine spectrum cannot be fortuitous We assume therefore that the mechanism of this emission is the same as that given above, namely, that under the action of suitable quanta and with some thermal activation, an iodine molecule is detached from BiI_3 The continuous or blurred aspect presented by the spectrum emitted in this case may be due to the disturbing influence of the polar BiI radical remaining in close proximity to the iodine molecule which is emitting radiation.

A. TERENIN.

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Jan 26.

[1] *Trans Faraday Soc*, **30**, 108; 1934
[2] Neujlin, *Phys Z Sov Un* **2**, 422, 1932.

Spectroscopic Constants of the Di-Atom PN

IN a recent paper[1], I ventured to predict that (*a*) "the internuclear distance of PN may be taken as closely approximating to the mean of the experimental values for NN and PP" (p. 28), and that (*b*) "it may be expected that experiment may show that PN has the highest bond constant and mean restoring force in the LK and KL periods" (p. 36).

At the time the paper was written, I was unaware of the experimental work on PN of Curry, Herzberg and Herzberg[2], but the results appear to justify both the above statements.

(*a*) r_e (calc.)[3] $= 1\cdot48_7$; r_e (obs) $= 1\cdot4869$ A.

(*b*) ω_e (expt.) $= 1337\cdot24$ cm.$^{-1}$, whence the bond constant $k_e = 101\cdot0\times10^4$ dyne cm.$^{-1}$ and mean restoring force $K = 3\cdot642\times10^{-4}$ dyne are derived. These are without doubt maximum values for the LK and KL periods.

The experimental data are consistent with the observed flattening of the periodicity curves with increasing period numbers The presence of maxima and minima of spectroscopic constants in the symmetrical sub-group of the tenth molecular group is not without interest in connexion with problems of polarity and bonding strength of di-atoms

C H DOUGLAS CLARK

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Feb 11

[1] C H Douglas Clark, *Proc Leeds Phil Soc*, **3**, 26, 1935
[2] J Curry, L Herzberg and G Herzberg, *Z Phys*, **86**, 348, 1933
[3] W Jevons, "Report on Band Spectra of Diatomic Molecules" (Camb Univ Press, 1932)

A Mycetozoan Parasite of *Zostera marina**

IN a previous note in NATURE[1] we pointed out the association of a *Labyrinthula*-like organism with the wasting disease of the eelgrass along the American Atlantic coast Since the publication of this announcement, we have performed a number of experiments in the laboratory and in the natural beds themselves, which indicate that this organism is a true parasite of *Zostera marina*. Communications from other investigators and examinations of specimens submitted from various points show also that this parasite is uniformly present in the infected beds on the Atlantic coasts of both Europe and America

The parasitic habit was first demonstrated in modifications of Cienkowski's moist chambers[2]. In these the actual migration of the spindle-shaped cells from fragments of diseased leaf and the invasion of healthy leaf tissue could be clearly followed. Consistent infection occurred in thirty slides, usually within eight to forty-eight hours. In only one case did a filamentous fungus make its appearance—a contaminated check preparation.

Field experiments were conducted in several beds near Woods Hole, Massachusetts Slips of diseased and normal leaf were fastened in alternate order to healthy green leaves Local darkening and characteristic streaking of the 'inoculated' leaves to form the pattern anticipated by this arrangement followed within one or two days The experiment was repeated four times during the later part of the summer and corresponding tests were made in aquaria with the same results. Sections prepared from the newly infected areas showed heavy infestations of viable *Labyrinthulæ* Such sections attached to clean plants brought about infection of the new host.

We were unable to grow the organism on artificial media or to maintain it long without its host in filtered sea water, but from microscopic observations and from field experiments it is evident that the *Labyrinthula* is capable of attacking and destroying healthy leaf tissue independently of other organisms The rapidity with which it produces infection indicates its extremely aggressive habit. Thus far it has not been identified with any of the described *Labyrinthulæ*.

It seems well established that the *Ophiobolus* isolated from diseased eel-grass by Dr. Petersen[3], Miss Mounce[4] and by Dr. Tutin[5] varies in abundance and activity over the affected areas. The mycelium of the fungus occurs in the Woods Hole region, but in extremely minor quantities—it is far from universally associated with the disease. We have not been able to find the pycnidia of this form upon any of the specimens from the coast of Maine, south, though they are very abundant upon the fruiting stems of plants sent us by Miss Mounce from St Andrews, and have been described by Dr Petersen as very profuse in the Danish beds

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* Contribution No 67, Woods Hole Oceanographic Institution and Journal Series Paper of the N.J Agr. Exp Station.

We could not discover the *Labyrinthula* in the longer, wider-leaf *Zostera marina, L*, from Nanaimo, Departure Bay, B C, on the Pacific coast, though this grass was spotted and infested with a variety of other parasites Despite their activities, the grass at Nanaimo was unusually abundant last year

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[1] Renn, C E, NATURE, **134**, 416, 1934
[2] Cienkowski, L, *Arch Microscop Anat*, **3**, 274, 1867
[3] Petersen, H E, NATURE, **134**, 143, 1934
[4] Mounce, Report of Biological Board of Canada, 1933, Ottawa, 1934
[5] Tutin, T. G, NATURE, **134**, 573, 1934

Wasting Disease of *Zostera marina*

THE variation in the width of the leaf of *Zostera marina* cannot be put down to any one particular cause In common with all water plants, the size of the leaf is probably a reflexion of the nutritional balance in the plant itself, as is shown to be the case by Pearsall and Hanby[1] for certain *Potamogeton* species

Many of the circumstances enumerated by Dr Cottam[2], such as reduced salinity, abnormal temperatures, short period of submergence, low light intensity, etc, by altering the nutritional balance, doubtless react to produce narrow-leaved plants

That the production of the narrow leaved plant is not a simple reaction is suggested by the fact that, in some places on the English coast, plants with leaves of all sizes grow mixed up together, while at other places, only *Zostera marina* var *angustifolia* can be found, though the large-leaved type was abundant in 1921 Nor is the size of leaf a matter of age alone, for these narrow-leaved forms flower just as profusely as the broad-leaved plants

All this goes to suggest that, in the disappearance of *Zostera*, one has to deal with a large number of circumstances and not with a single catastrophic event

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March 6

[1] Pearsall and Hanby, *New Phytologist*, **24**, 1925
[2] NATURE, **135**, 306, 1935

Fibre Saturation Point of Wood

THE fibre saturation point of wood (f s.p), which is the minimum moisture content in equilibrium with a saturated atmosphere, is commonly estimated indirectly from the point at which (*a*) shrinkage begins, or (*b*) a sudden increase occurs in the compressive strength[1,2], on lowering the moisture content from the green state. Though these methods agree fairly well in defining the f s.p of Sitka spruce as about 25 per cent moisture content[3] (basecrsity Field[4] weight of the wood), it is found that many factors, show measurable shrinkage at much higher moisture contents than those indicated by method (*b*)

Other research[4] at this Laboratory, which required the vapour pressure isothermal of Sitka spruce flour above 95 per cent relative humidity, showed that, on adsorption, moisture contents of about 35 40 per cent were attained before saturation was reached, which considerably exceeds the figure quoted above

Desorption, on the other hand, showed a measurable drop of about 0 4 per cent in relative humidity on a slight drying from moisture contents as high as 90 per cent, the effect probably persisting up to even higher values Others[5] have noticed that the loop does not close at the adsorption saturation value, but have not investigated higher moisture contents Thus there is no well defined f s p, and there may well be a large moisture content hysteresis at the saturation value itself, which suggests that the shrinkages observed at high moisture contents are associated with the drop in vapour pressure found on the desorption curve

The discrepancy between the f s p obtained from method (*b*) and that from the adsorption isothermal may be accounted for by the compression which, opposing the swelling presure of the wood, raises its vapour pressure[6], thus bringing to saturation a sample of 25 per cent moisture content that was initially unsaturated In support of this view, samples of Sitka spruce of higher strength in compression are found to show a lower apparent fibre saturation point[3]

Plotting the observed shrinkage against swelling pressure calculated from the desorption curve shows a decreasing strain stress ratio on drying, corresponding to the decrease of compressibility of wood which is already well known below 25 per cent moisture content

WILFRED W BARKAS

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[1] Chaplin, New Intl Assn of Testing Materials, 1931, Zurich
[2] Wilson, U S Dept of Agr *Bulletin* No 282, March 1932
[3] Unpublished data by F P R L on Sitka Spruce
[4] Barkas, NATURE, **130**, 699, 1932
[5] Urquhart and Williams, *Shirley Inst Mem*, **3**, 197, 1924
[6] Katz, *Koll Chem Beih*, **9**, 1, 1917

The Smell Emitted by Seaweeds

THE offensive odour given off from masses of rotting seaweed which occasionally accumulate on the shore is a not unfamiliar phenomenon of the sea side There can be little doubt that an important constituent of the smell is sulphuretted hydrogen produced perhaps in part by the putrefactive reduction of the ethereal sulphates which form so marked a feature of many marine algæ

Belonging to a somewhat different category is the particularly unpleasant smell reminiscent of phosphorus given off on drying certain members of the genus *Polysiphonia* I have recently been able to identify methyl sulphide as the odoriferous principle in this case The origin of this substance is less easy to account for and investigations directed towards the elucidation of this question are in progress Preliminary experiments would suggest that methyl sulphide is a product of modified vital activity rather than a post-mortem decomposition product, in as much as it begins to be evolved very shortly after the seaweed has been gathered and is not apparently given off by material which has been dipped in boiling water

The natural occurrences of methyl sulphide are not numerous, and it is worthy of note that one of these is petroleum from Ohio, the finding here recorded is therefore at least not inconsistent with the theory of the algal origin which has been suggested for some oil-fields.

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March 18

Germination of Resting Fungal Spores

I HAVE read with interest Mr Robert McKay's letter[1] on the germination of oospores of *Peronospora Schleideni* He notes the remarkably persistent oogonial wall, which "forms an additional protective layer" around the oospore, and the still more persistent oospore wall In germinating these highly resistant spores he lays claim to no special method in course of time, in this case of years, the spores germinate when placed in water

During the last ten years, I have spent a considerable amount of time in an attempt to devise a reliable method of obtaining the germination of the similar, though not quite so resistant, oospores of *Phytophthora Cactorum*, in sufficient numbers for cytological study. After trying many and varied 'agents', I finally obtained germination in quantity by exposing three-months old oospores to a temperature of 1°–3° C for a month and then soaking them for one or two weeks in water, kept constantly renewed It appeared later that the spores could be older, and the refrigeration period longer, and still give an equally good result[2].

When comparing my experiments with those of other workers upon the germination of resistant spores, I felt that we had no logical method of approach to the problem It was by trial and error that results were finally obtained in some cases one method, in others another, chanced to be effective At the risk of appearing to state the obvious, I would direct attention to the following facts that suggest a line of attack in such experiments.

(1) That the wall of these resistant spores is, as a rule, at least two-layered · the inner thick and of a reserve substance such as a hemicellulose ; the outer thin and of 'fungus cellulose', and practically impermeable

(2) That the substances composing both wall layers are in a colloidal state

(3) That germination cannot take place until (*a*) the spore has fully matured—a process, not at all understood, which involves a time factor ; (*b*) the wall is rendered sufficiently permeable to admit water and oxygen.

(4) That the various devices tried and claimed as agents initiating germination (namely heat, cold, acids, carbon dioxide, bacteria, etc.) appear to do one of two things, provided they are of a suitable intensity or concentration . (*a*) form small cracks in the wall, (*b*) bring about a change of colloidal state. (Agents such as bacteria may be effective through carbonic acid produced.)

(5) That since the spore, though dormant, is a living thing with carbon dioxide accumulating within it, the change in the nature of the wall will in course of time come from inside, that is, time is a factor in germination as well as in maturation.

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[1] NATURE, 135, 306, Feb 23, 1935

[2] *Trans Brit Myc Soc*. 15, 294–310, 1931, and 19, 157, 1935

Extrusion of Cells in the Tubules of the Epididymis

MR. P. G. 'ESPINASSE has remarked[1] that the extrusion of nuclei which has been observed to occur from the epithelium of the oviduct in the mouse could not be closely related, as had been suggested, to the œstrous cycle His conclusion on this point seems to derive indirect support from a comparable phenomenon which takes place in the epididymis of the mouse and rat In those tubules of the epididymis which are lined with a single layer of columnar cells the nuclei of which are close to the basement membrane, a process of cellular extrusion is particularly well seen, though it occurs also in other tubules where the epithelium is cuboidal

Microscopic sections suggest that the actual process could be reconstructed as follows Here and there a nucleus becomes separated from the uniform row of its fellows and advances towards the lumen of the tubule. As it approaches the free surface, it may be preceded by a bulging of the cytoplasm into the lumen Eventually the nucleus, sometimes surrounded by cytoplasm, becomes detached and lies free in the cavity of the tubule This extruded body often appears to be a living cell, showing no pyknosis or other obvious signs of degeneration

Whatever significance may be attached to the phenomenon, it appears to be of frequent occurrence in the healthy epididymis of the adult mouse and rat, and cannot readily be attributed to any periodical cycle connected with the sexual function.

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Feb. 28

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[1] NATURE, 134, 738 ; 1934.

Hydrogen Ion Concentration of the Alimentary Canal in Psychodidæ (Diptera)

INSECT physiology, and particularly the physiology of digestion, is more or less intimately correlated with the life-history and other environmental factors. An attempt has therefore been made to find out the correlation, if any, between the hydrogen ion concentration of the alimentary canal and the different feeding habits in the family Psychodidæ, which contains two sub-families, namely, Phlebotominæ and Psychodinæ. The former is easily separable from the latter by its blood-sucking habit.

The entire alimentary canal of four common species belonging to two different genera was dissected in a minimum quantity of bromthymol blue and carefully laid out on a slide. The subsequent reaction was enhanced by puncturing a few holes in the thicker region of the alimentary canal The changes in colour of the gut in all the four species were carefully noted and their approximate pH value determined by comparison with a Hellige standard colour disc for bromthymol blue The ranges of variation of pH in each species are those of different regions of the gut and to some extent include the individual variations.

The accompanying table shows that the degree of variation in the pH of the alimentary canal is small, yet it is suggestive enough to indicate that the alimentary canal of the blood suckers is slightly more acidic than that of those which do not suck blood The relation of the acidity of the gut with the development of flagellates inside it is being investigated and will be published elsewhere.

	pH value
Phlebotomus papatasii, Scop, (Mammalian blood sucker and ***Leishmania tropica*** carrier)	6 2–6 4 Stomach—Little or no reaction
Phlebotomus argentipes, Ann and Brun, (Mammalian blood sucker and ***Leishmania donovani*** carrier)	6 2–6 4
Phlebotomus minutus (sensu lato), Rond	6 4–6 6
Psychoda alternata, Say ***sexpunctata***, Curt (Non blood sucker)	6 6–6 8

S MUKERJI.

Kala-azar Enquiry,
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Jan 24

Simultaneous Travel of a Surge of Stress and a Group of High-Frequency Waves of Stress in a Steel Wire

THAT a high frequency longitudinal vibration will travel more slowly than a low frequency one may be qualitatively foretold from Rayleigh's[1] treatment of the effect of lateral inertia on the natural period of longitudinal vibration of cylindrical rods. However, when Rayleigh's formula is applied to the case given by Dr. Wall[2], where the wave-length is stated to be 18 inches and the diameter 0 123 in, the effect of lateral inertia is found to be negligible

Rayleigh's formula has been experimentally investigated, by R. W. Boyle and myself[3] and by Muzzey[4], and found to be applicable over a range of the ratio of wave-length to diameter including this case. It is suggested that the necessity of postulating a hitherto unknown effect may be avoided by assuming that the group of waves has a higher frequency than that given by Dr Wall, determined possibly by the natural period of a clamp, this high frequency being 'modulated' at the inter-clamp frequency by successive reflections, and 'demodulated' in the amplifier, which the oscillograms show to have the necessary characteristics.

Dr. Wall's oscillograms show that the ratio of the two velocities is about 1 : 1·3 and Poisson's ratio for iron may be taken as 0·3 (Kaye and Laby). These values inserted in Rayleigh's formula give a ratio of diameter to wave-length of 1·2. The results of Boyle and myself show that Rayleigh's formula is *not* applicable when this ratio exceeds 0·55, probably due to the neglect of shear stresses, the approach to resonance of radial vibration, and viscosity Field[5] has given an analysis which includes these factors, and whether or not this analysis can be applied to explain the interesting results given by Dr Wall, it is clear that Dr Wall's method of measuring the velocity of longitudinal vibrations may be adapted to an experimental investigation of the factors included in Field's analysis

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[1] "Theory of Sound", vol 1, p 251

[2] NATURE, **135**, 151, 1935

[3] *Canad J Research*, **5**, 601, 1931

[4] *Phys Rev*, **36**, 935, 1930

[5] *Canad J Research*, **11**, 254, 1934

Science and Social Progress

MAY I suggest that the decline of the adventurous spirit is due not so much to standardisation and mechanisation, as might be gathered from the leading article in NATURE of February 16, p 245, as to specialisation ? A specialist, as I have said elsewhere, is "a human being who has narrowed the sphere of his activity at the expense of his social instincts, thereby becoming but a fraction of a man He sees a field of activity as brightly lit, perhaps, but as limited as the field of a microscope, and not infrequently it is as though the microscope was a little out of focus There is a blurring as of things too close to the eyes to be distinctly seen "

I am under no illusion that specialisation can be dispensed with altogether, but I am heterodox enough to believe that we should be more truly civilised if there were more jacks of all trades and fewer masters of one. How can any man who has only read, let us say, Chapter xx of the 'book of life' hope to acquire that comprehensive vision of the human adventure in time and space, so essential to ensure sane social development ?

Since mechanisation has been mentioned, I should like to take this opportunity to combat the belief now being revived in various quarters, that machinery, after all, does not cause unemployment. It will be seen that the subject is not irrelevant This particular fallacy was exposed 116 years ago by Jean Sismondi as follows · "Every new product must in the long run give rise to some fresh consumption But let us desist from our habit of making abstraction of time and place Let us take some account of the obstacles and the friction of the social mechanism And what do we see ? The immediate effect of machinery is to throw some of the workers out of employment. A certain kind of equilibrium, it is true, is re-established in the long run, but it is only after a frightful amount of suffering."

In short, it is little consolation to a man thrown out of employment now, to know that 'in the long run' and 'on the average' scientific and technological development creates new opportunities In the long run (as I think Mr. Keynes once remarked) we are all dead Adjustment of the individual to mechanical progress, with less of both short run and long run unemployment, would be easier if men were less specialised, better equipped for turning readily from one type of employment to another

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The Oblong or Truncate-tailed Ocean Sunfish, *Ranzania truncata*, at Mauritius

IN studying the history and distribution in the three great oceans of the very rare pointed tailed sunfish *Masturus*, I have had to disentangle it in the literature from the other two genera of the family Molidæ—*Mola*, the round-tailed genus, and *Ranzania*, the truncate form. The former, known since Roman times, is found in the three central oceans, but to my surprise, *Ranzania*, while recorded from the Atlantic and Pacific, has seemingly never been described from the Indian Ocean. However, there is known to me an unpublished figure and description of it in this ocean and it seems well to put these on record.

Nicolas Pike was U.S. Consul at Port Louis, Mauritius, from 1867 until 1874. During these years, he made extensive natural history collections, drawings and studies and brought back to New York in 1874 eight volumes of drawings of fishes, most of them in colour. In 1905, these were purchased by J. Pierpont Morgan and presented to the library of the American Museum of Natural History. Finding these among our treasures, I published in 1929 a sketch of Pike's life and an analysis and description of his 486 paintings[1] of fishes. These I listed alphabetically under the name of the fish. Number 324 is his "*Orthagoriscus truncatus* Retz., molle, poisson lune". The figure is noted as made from a stuffed specimen in the little museum at Port Louis, June 25, 1873, and is found on pl. 8 of vol. 6.

This figure is somewhat crude but plainly that of *Ranzania truncata* in its oblong form, truncate tail, in the relative positions and conjunction of dorsal, caudal and anal fins; in the presence of bars on the lower side of the head as far back as the pectoral fin; and in the imperfect markings on the hinder part of the side with some few on the dorsum. Here is Pike's brief and untechnical description:

SUNFISH—CREOLE MOLLE

Height of body less the half total length. Skin very smooth, divided on back into small hexagonal scutella [drawing of one with dots]—only the raised dots visible elsewhere. It appears to have been marked nearly all over with lines, blots and dots but so effaced I can only trace what are shown in sketch. I think the broad stripe on bare part in front of D was yellow, also stripes between lines; but where I have put large round spots, they were either white or yellow with a dark center. The entire color is a grey brown now. Snout round—a dark boss of some kind above snout, a deep hollow for P behind them—2 have scutes in front.

Numbers [of fin rays] about D' 15 or 16—A 15 or 16—C 23 or 4, P 12. Above boss on head is a rise and beyond a depression (rough sketch) along back at top.

This figure and description made sixty-two years ago constitute the first and only record known to me of the presence of the oblong sunfish in the Indian Ocean. Thinking that Barnard might have a record of it for South Africa, I consulted his "Monograph"[2]. In this he lists three specimens in the South African Museum, from False Bay, Table Bay and Dassen Island—all to the west of Cape Agulhas, through which runs the meridian dividing the Indian and Atlantic Oceans.

Ranzania is an inhabitant of warm seas, and this is very far south for it. The average latitude for the three localities is about 34° S. and the mean annual temperature is about 60° F. This is cold water for this sunfish and hence one may judge that *Ranzania* is not endemic in Cape waters. Add to this the fact that it is an exceedingly poor swimmer and hence could scarcely have reached South Africa by its own locomotive powers, then how did it come to these parts?

The answer is to be found in the currents in the western Indian Ocean. *Ranzania* is found at Mauritius, in the path of the Southwest Drift of the Equatorial Current of this ocean. In about lat. 30° S., this drift unites with the Mozambique Current to form the Agulhas Current, which sweeps around the Cape of that name, and turns north-westward around the Cape of Good Hope.

In my judgment, *Ranzania* was brought from Mauritius or elsewhere in the western Indian Ocean by these currents to South Africa, and, since False and Table Bays act as natural traps for the back-wash of the current as it swoops west and north-west, these specimens were thus stranded. These three captures of *Ranzania* in South Africa are to me so many additional proofs of its occurrence in the western Indian Ocean.

E. W. GUDGER.

American Museum of Natural History,
New York City.
Feb. 11.

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[1] Gudger, E. W., "Nicolas Pike and his unpublished Paintings of the Fishes of Mauritius, Western Indian Ocean, with an Index to the Fishes." *Bull. Amer. Mus. Nat. Hist.*, 58, 489-530, 8 text-figs., 1929.

[2] Barnard, K. H., A Monograph of the Marine Fishes of South Africa (*Ranzania truncata*, pp. 989-990, text fig. 32), *Ann. S. African Mus.*, 21, 1927.

Diffusion of Hydrogen through Aluminium

THE solubility of hydrogen in aluminium has been determined by Sieverts[1], Röntgen and Braun[2], and Röntgen and Möller[3]. These authors agree that the gas is completely insoluble in the solid metal at all temperatures below the freezing point. There are certain difficulties in the direct determination in this case, and we have therefore attempted to detect the diffusion of hydrogen through the solid metal. The method used is that described in a recent paper[4].

We find that hydrogen diffuses through aluminium at a rate which is easily measurable above 400° C. Preliminary measurements show that it follows the usual diffusion law with regard to the effects of temperature and pressure, namely,

$$D = \lambda\sqrt{P}\, e^{-b/T},$$

b having a value of about 14,000. The rate of diffusion at 400°-600° C. is of the same order as that of hydrogen through copper, but the temperature coefficient is much larger. We hope later to publish exact data.

The fact that hydrogen can diffuse through solid aluminium shows that it must be soluble, but does not indicate the degree of solubility.

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C. E. RANSLEY.

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General Electric Company Ltd.,
Wembley.
March 8.

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[1] *Z. Elektrochem.*, 16, 707; 1910.

[2] *Metallwirtschaft*, 11, 459; 1932.

[3] *ibid.*, 13, 81 and 97; 1934.

[4] *Proc. Roy. Soc.*, in the press.

Atmosphere of the Planet Mercury

I NOTICE, in the Supplement to NATURE of February 9, that the existence of an atmosphere on the planet Mercury has again been pronounced impossible on account of the small mass of the planet.

As a systematic observer of Mercury, with a powerful telescope, in 1927, 1928 and 1929, I wish to state, in full accordance with Schiaparelli, that the dusky spots of the planet are frequently faded, while some of them are sometimes even totally extinguished, by local clouds. These may be due to dust, and appear white, or even brilliant, on the limb, stretching there occasionally over three thousand miles in length, and it is thus obvious that such phenomena establish beyond doubt the existence of the highly rarefied atmosphere of Mercury, which is invisible, like that of Mars.

E. M. ANTONIADI

Paris,
Feb. 27.

Points from Foregoing Letters

FOLLOWING upon an improvement in his apparatus, Dr. F. W. Aston finds higher values for the masses of hydrogen, deuterium, helium and carbon atoms; the new values are in better accord with those deduced from energy changes during the artificial disintegration of those elements. The new determinations were made by comparing with the mass-spectrograph, to which a new collimator with variable slits was added, the masses of doublets (that is, atoms and groups of atoms having nearly the same mass/charge ratio).

Prof. A. J. Dempster describes a new way of obtaining positively charged ions of the metallic elements, including gold and platinum, for use with the mass spectrograph. He employs a spark coupled inductively to a *high-frequency oscillating spark circuit*, and obtains many ions with multiple charges.

The red colour of certain auroræ may be due to electrically excited oxygen, which emits a 'triplet' of wave-lengths in the red region of the spectrum. Mr. L. Harang and Prof. L. Vegard have determined more accurately the wave-length of the strongest component of the triplet by means of an interferometer, and find that it agrees with the wave-length observed by Hopfield in the case of oxygen in the OI state.

From spectroscopic analysis of light obtained with silver compounds of hydrogen (H) and heavy hydrogen (D), the ratio of the (reduced) masses of H and D atoms has been deduced; it does not agree with the ratio deduced from their atomic weights. Mr. L. Hulthén calculates that this discrepancy would be accounted for if the four outermost electrons of the silver atom took part in the rotation of the nucleus, which rotation is assumed to be responsible for the band spectrum.

Prof. A. Terenin states that when SnI_4 vapour is decomposed by ultra-violet light, visible light is emitted corresponding to that characteristic of iodine molecules. This he considers shows that, under the influence of light quanta, not only are the bonds of the original molecule broken, but also an instant recombination between the liberated radicles or atoms can take place. Prof. Terenin accounts in this way for the yellow fluorescence of bismuth tri-iodide which falls in the same region as the iodine spectrum.

Mr. C. H. Douglas Clark directs attention to the fact that the value for the inter-nuclear distance between phosphorous and nitrogen, and also other molecular constants, as calculated by Curry, Herzberg and Herzberg from observations on the spectrum on the PN molecule (phosphorus vapour electrically excited in nitrogen gas) agrees with certain qualitative predictions which he recently made, unaware of their experimental work.

Evidence that a slime-mould (similar to *Labyrinthula*) is responsible for the wasting disease of the eel grass, *Zostera marina*, along the Mediterranean Atlantic coast, is adduced by Mr. C. E. Wren. A fungus, *Ophiobolus*, has also been suggested as the causative agent, but Mr. Wren finds that it is not always associated with the disease.

Dr. R. W. Butcher believes that the narrow-leaved variety of *Zostera*, which is more resistant to the wasting disease, is produced by a change in 'nutritional balance', and that the disappearance of the wide-leaved variety is due to a variety of circumstances.

Mr. W. W. Barkas finds that the moisture content of sprucewood flour (Sitka or tide land variety) in equilibrium with saturated air, that is, its fibre saturation point (f.s.p.), is greater when the wood is being dried from a moist state (desorption) than when it is absorbing moisture from the air (adsorption). The f.s.p. is also frequently deduced indirectly from the percentage moisture when (1) shrinkage occurs, or (2) sudden increase in compression strength occurs, but in the case of many woods the values obtained by these two methods do not agree. Mr. Barkas suggests that the compression which, opposing the swelling pressure of the wood, raises its vapour pressure also causes a decrease in the water content needed for saturation and accounts for the divergence in the f.s.p. deduced by methods 1 and 2.

The unpleasant smell given off on drying by certain red sea weeds (genus *Polysiphonia*) is due to methyl sulphide, according to Dr. P. Haas. He points out that methyl sulphide is also found in petroleum from Ohio, a fact which supports to some extent the sea-weed theory of the origin of petroleum.

Mr. S. Mukerji finds that the blood-sucking minute moth flies (*Phlebotomus*) have their alimentary canal somewhat more acid (lower pH) than the non-blood-sucking species. The blood-sucking *Phlebotomus papatasii* is a carrier of *Leishmania tropica*, a protozoon which causes the malaria-like fever kala-azar in India.

Mr. D. O. Sproule points out that, according to Rayleigh's formula, high-frequency vibrations travel more slowly than low-frequency ones, but the difference in their speed in a steel wire, recently reported by Dr. Wall, is too great to be explained in that way, unless the frequency of the group of waves was rendered greater by the natural period of one of the clamps used. Mr. Sproule points out that Dr. Wall's method of measuring the velocity of longitudinal vibrations would be useful in investigating shear stresses, viscosity and radial vibration.

Research Items

Pollen Analysis from the Norfolk Fens. An attempt to reconstruct the conditions of discovery of a bronze spear head with loops at the junction of socket and wings of the Middle Bronze Age has recently been described by H. and M. E. Godwin, J. G. D. Clark and M. H. Clifford (*Proc. Prehist. Soc. East Anglia*, 7, pt. 3). The discovery was made some years ago at Queen's Ground, Methwold Fen, by Mr. John Harrod, of Methwold, from whom it was obtained for the University Museum of Archæology and Ethnology, Cambridge. The site was visited by members of the Fenland Research Committee, to whom Mr. Harrod was able to indicate the horizon of discovery very closely. The spear-head was found at the base of the lowest draw of peat. The level indicated by attendant circumstances was confirmed by recognition of a well-marked horizon of the surface of the undisturbed peat in the disused trench. Uncontaminated samples of peat were taken, the peat in each instance overlying chalky boulder clay. As the result of the pollen analysis, bore *A* appears to have included three major phases: (*a*) an early phase with high birch and pine pollen values, (*b*) the middle phase with overwhelming dominance of alder pollen, and (*c*) the latest, with co-dominance of ash and alder pollen and showing in its last stages small amounts of beech pollen and high values for hazel pollen. The earliest phase certainly represents the end of the Boreal climatic period and the base of (*b*) the early Atlantic. This is supported not only by the change over from pine and birch to alder, but also by the presence in small amounts of oak, elm and lime, with the two latter genera at first dominant over the oak. Probably the change from (*b*) to (*c*) indicates a change to generally drier soil conditions with an extension of the fen area locally covered by fen carr (scrub) or fen woods. The record of beech pollen below a late Middle Bronze Age horizon is of interest to botanists since precise evidence is lacking of the history of appearance and spread of this tree in Britain.

'Fossil Tradition' in Stone Implements. Under this title, M. A. Vayson de Pradenne contributes to *Antiquity* for March a study of certain anomalies encountered in stone age industries—more particularly in certain industries of North Africa which have frequently been the subject of comment and conjecture. Excavators have long noticed the occurrence in prehistoric deposits of objects with two distinct patinas. Thus in the Mousterian deposits of La Quina, flints shown to belong to the lower deposits by their deep yellow patina have been found in the upper deposits. They had been rechipped and used again by the later inhabitants of this site, as is shown by the white patina characteristic of the upper deposits. Certain very peculiar specimens are found in North Africa with rough chipping on one side only accompanied by a tang handle of neolithic type. Since 1919, Reygasse has described numerous artefacts at Bir-el-Ater of which the Mousterian character is supplemented by tanged specimens. Further, there is a whole group of various implements which is supplied with handles. This Aterian industry is widely distributed throughout North Africa and is generally found on the surface or at a slight depth in brick-earths the upper portion of which has been re-arranged. In the Abri Alain culture, recently described by M. Pallary (see NATURE, 134, 975; 1934), are found in a group of contrasted association certain tanged objects exactly like those of the neighbouring Champ de Tir of Eckmuhl, and it cannot be doubted that the type was borrowed by the inhabitants of the Abri Alain from the old industry nearby, which was as 'fossil' to them as it is to us. Other caves near the Abri Alain, as recorded by M. F. Doumergue, include in their culture patinated flints of a palæolithic facies, also from the Champ de Tir. These implements introduced a new type into the industry which took them over, and serve to show that identity of type need not indicate either direct connexion or contemporary influence.

South African Fisheries. In Dr. Cecil Von Bonde's Report, No. 11, of the Fisheries and Marine Biological Survey, Union of South Africa, for the year ending December 1933 (1934), a résumé of operations of the R.S. *Africana*, and a list of the stations and salinity results occupy the first part, the second part containing investigational reports. Of these, the report on savings-trawl investigations in relation to the conservation and regulation of the Agulhas Bank sole fishery by J. M. Marchand is of much importance. The Agulhas Bank mud sole or east coast sole, *Austroglossus pectoralis*, becomes sexually mature and spawns for the first time at an average minimum length-size of 12 in. With a size-limit of 12 in. the percentage of undersized and immature soles in the commercial catches procured with the trawl-gear at present in use is too high. Investigations were carried out in order to find trawl-gear of such form, construction and mesh dimension as would allow the escape of as high a percentage as possible of soles of less than 12 in. in length, at the same time guarding against the escape of too many mature and marketable fish. The main result is to show that the use of a larger-meshed saving-panel in the back or upper side of the cod end of the trawl demonstrates an enormous saving of small, immature and non-marketable fish, especially soles, but also other species; the percentage escapes of marketable soles is very low. It is recommended that a certain defined breeding area be closed to trawling for five years, and that a general and special mesh and dimensional regulations be enforced with respect to trawl-nets, a savings-panel to be inserted in the cod-end.

Feeding Mechanism in *Diastylis*. Mr. Ralph Dennell, in describing the feeding mechanism of the cumacean crustacean *Diastylis Bradyi* (*Trans. Roy. Soc. Edinburgh*, 58, Part 1, No. 6; 1934), has carried out his researches both on the living animal and on careful preparations of the mouth parts, which show the features of a typical filtratory malacostracan. There is, however, a peculiar median process projecting into the filter chamber which is of great importance in the working of the feeding mechanism and apparently has not been noticed before in the Cumacea. The filter current is due to the pumping action of the maxillæ and maxillipeds, made possible by the maxillary valve and median process, and to the action of the epipodites in sucking a subsidiary current through the filter chamber. It is helped to a large extent by the respiratory current. The author suggests that the ancestral cumacean probably possessed certain features shown by the primitive *Gnathophausia* and *Lophogaster*. He intends to follow up the present investigation with one on the feeding mechanism of *Apseudes*, in the hope that it will be possible to describe the evolution of the *Cumacea* and *Tanaidacea* as functionally derivable from a group of primitive mysids which took to burrowing in mud, as a change of habitat is shown in other cases to have a profound effect on the crustacean feeding mechanism.

Hemipterous Insects from Ireland. Mr. J. N. Halbert has recently published a lengthy annotated list of the Irish Hemiptera, especially of the Heteroptera and the Cicadina group of the Homoptera (*Proc. Roy. Irish Acad.*, **42**, (B), No. 8, 1935). For the first time information on the insects in question is brought together with the object of providing a comprehensive survey of the distribution of the species occurring in Ireland. As might be expected, the Heteroptera, or plant bugs, have been more extensively collected than the Cicadina. Out of 455 British species of this suborder, 253 are shown to be found in Ireland. This relative paucity of the Irish fauna is regarded as being due more to past geological changes, resulting in isolation, than to such ecological factors as climate and soil. Of the Cicadina, and the allied Psyllina, the Irish species number 153, or less than half of those recorded for the British Isles as a whole. These two groups, however, have been less intensively collected, their identification is often beset with difficulties and much work remains to be done. Their species are merely enumerated without annotations, the list being tentative in character. The paper as a whole extends to more than 100 pages and is provided with a useful bibliography dealing with Irish faunistic records.

Epidemiology of Winter Outbreaks of Parasitic Gastritis in Sheep. In the course of an epidemiological inquiry into the severe outbreaks of parasitic gastritis which occurred during the winter months of 1933–34 in the British Isles, Mr. E. L. Taylor (*J. Comparative Path. and Therapeutics*, **47**, pt. 4, Dec. 1934) found that the epidemic was chiefly associated with heavy infections of species of *Trichostrongylus*. *Haemonchus* and *Nematodirus* did not appear to have been involved. Inquiries on the Romney Marsh showed that 43 farmers lost £10,341 during the outbreak. Most of these losses, however, took place while the sheep were away from the Marsh for winter grazing. The outbreak was associated with a prolonged period of drought. A gradual storage of potential infective material probably took place on the ground during the drought, which may or may not have terminated in a mass development of infective larvæ, depending upon the advent of a period of damp weather of sufficient duration for the infective larvæ to develop. Experiments on the effect of diet on the susceptibility of lambs to worms showed that more worms develop in sheep fed on a deficient diet than in those receiving a full ration; and that those on an adequate diet eliminated their worms more readily than those on an inadequate diet. After a period of drought the herbage is short, scarce and of very poor quality, leading to maximum intake of infective larvæ, and actual under-nourishment of the sheep. It is advised that, where a shortage of pasture is threatened, the sheep should receive an ample allowance of concentrated food and that use might be made of the application of nitrates to some of the pastures towards the end of the summer, to stimulate the growth of grass of a more nutritious quality.

Improved Methods of Vegetative Propagation. An article entitled "Working up Stock" appears in the *Fruit, Flower and Vegetable Trades' Journal* of February 2, 1935. The identity of the author is hidden behind the pseudonym "Crusoe", but the subject-matter reveals a vigorous awakening of the nursery trade to present-day conditions, as relieved by the provision of import duties on foreign produce. It is shown that seed propagation of several plants is slow in comparison with the newer methods of vegetative propagation suggested by the article. Lupins may be raised as cuttings from the abundant shoots at the base of old stems. *Anchusa* may be multiplied by root cuttings, but attention must be paid to polarity: the piece of root must be planted in the same position in which it naturally grows. Gaillardias and *Gypsophila* may be propagated from pieces of the fine root. An interesting improvement relates to the propagation of hyacinth bulbs. The central conical stem is scooped away until the bases of the scales are exposed. Planting in ordinary soil induces the formation of innumerable small bulbils from the scales; these can then be grown to suitable size. It is interesting to note that these methods of vegetative propagation are as prolific as seed propagation, but have the additional advantage that all the vegetative produce from one plant (that is, a clone) is uniform in colour, shape and size—a very important factor in commercial work.

Rust Fungi in Scotland. The study of fungi rests, perhaps more than that of any other group of plants, upon traditions of observation and nomenclature established by highly scientific amateurs. Scotland had her share of such men. Greville really initiated the study in 1823–28 by the publication of the "Scottish Cryptogamic Flora". He was followed by the Rev. M. J. Berkeley, and in 1879, the Rev. John Stevenson published "Mycologia Scotica". Many rust fungi were described by these authors, but Trail's "Revision" of 1890 was the latest authoritative account until 1934. The Edinburgh Botanical Society has recently published a paper on "The Distribution of the Uredineæ in Scotland" by Dr. Malcolm Wilson (*Trans. Edin. Bot. Soc.*, **31**, pt. 3, 345–449; 1934). Records are classified into eleven districts, each being a natural division bounded by watersheds. Trail's records have been more than doubled in number in the present publication. The account is not merely a list of new records, but also attempts to trace the influence of several factors on distribution. Some difficult problems are disclosed. *Puccinia vincæ*, for example, occurs in only one station, though *Vinca minor* and *V. major*, its hosts, are widely distributed. *P. agrimoniæ* and *P. perplexans* have similar local distribution, and attack plants common in all parts. *Phragmidium rubi* and *Puccinia sonchi* occur only near the sea, though their hosts are found abundantly inland. Several species occur in Scotland, but not in England, whilst *Puccinia Porteri* and *Uredinopsis filicina* are new British records.

Clay Minerals. In Prof. Paper 185G of the United States Geological Survey, C. S. Ross and P. F. Kerr continue the record of their investigation of the clay minerals by chemical, optical, X-ray and dehydration methods. In 1931 they described kaolinite, dickite and nacrite, and their present study shows that *halloysite* is a fourth member of the group, related to, but distinct from, kaolinite. Previously described as amorphous, halloysite is now known to have a crystal structure. The X-ray diffraction pattern has a number of lines in common with that of kaolinite, but in each case there are independent sets of lines. Like kaolinite, halloysite appears to be always the result of weathering, whereas dickite and nacrite are characteristically hydrothermal products. *Allophane* is a genuinely amorphous material that is commonly associated with halloysite. It has no crystal structure and no definite chemical composition. The name includes all materials that can be regarded as mutual solutions of silica, alumina and water with only minor amounts of bases.

Recent Developments in Molecular Rays. I. V. Gullemin has discussed recent work—since 1931—on molecular rays (*J. Franklin Inst.*, Jan. 1935). The scattering of molecular beams by gases has been calculated on quantum theory and also measured experimentally, with satisfactory agreement. The diffraction of molecular beams on crystal surfaces has been observed—this phenomenon is often obscured by adsorption and re-evaporation after a finite time. Magnetic and electric dipole moments have been measured for a number of atoms and molecules, including the hydrogen atom measured by Rabi under conditions such that the proton moment may be determined. Experiments have been devised to examine the re-orientation of atoms oriented by magnetic field when passed through a second field at an angle to the first. A number of other applications of the method are described, and a number of references are given.

Crystal Oscillators for Radio Transmitters. At a meeting of the Wireless Section of the Institution of Electrical Engineers on March 6, a paper was read by Messrs. C. F. Booth and E. J. C. Dixon on the application of the piezo-electric crystal oscillator to radio transmitter problems. This paper comprised an account of the work carried out by the Radio Section of the Post Office between 1925 and 1934 in the development of the use of quartz crystal oscillators in a number of different applications, of which the most important was the control of the carrier frequency of short-wave transmitters employed for overseas radio services. A description was given of the results of a comprehensive investigation of the chief characteristics of different types of quartz crystals, and the manner in which they must be used in order to secure the highest constancy of frequency. Particular attention has been paid to the effect of temperature on the frequency of the crystal oscillator, and special constant-temperature ovens have been designed for the oscillators used for the control of transmitters operating commercial radio-telephone services. The concluding section of the paper gave the results of a study of the performance of frequency-controlled transmitters in actual service. The graphical records show that it is possible to keep the frequency of a transmitter under strict control for periods up to two years, during which it is only on rare occasions that the variations exceed the limits of tolerance set by international agreement.

Chemistry of Fats. Prof. T. P. Hilditch (*Chemistry and Industry*, **54**, 139, 163, 184, 1935), in his Jubilee Memorial Lecture to the Society of Chemical Industry, directed attention to recent investigations of the chemical composition of fats. It had been assumed that the normal constituents of fats and oils were tristearin, tripalmitin and triolein, other substances being regarded as abnormal. It is now known that some of the supposed fatty acids are mixtures of two other acids in equimolecular proportions, margaric acid, for example, consisting of palmitic and stearic acids. Again, the assumption that simple triglycerides (containing three identical fatty acid radicals) are predominant is incorrect: in the natural fats the triglycerides are usually mixed. The major component acids of a fat often exceed three and may be as many as ten or twelve in number, and their relative proportions vary widely in different cases. In the case of fruit-coat fats, the major component acids are practically only palmitic, oleic and linoleic acids, but in many other seed fats, other quite specific acids are found. Cruciferous seed-fats, for example, contain large quantities of the unsaturated erucic acid, Umbelliferæ contain petroselinic acid (an isomer of oleic acid), etc. What Prof. Hilditch calls an 'even distribution' rule appears to operate in regulating the composition of the glycerides. A number of general questions, such as the conversion of carbohydrates into fat in living organisms, and the catalytic hydrogenation of fats, were also considered.

Effect of Ozone on Rubber Insulated Cables. It has been well known for many years that ozone attacks rubber, producing cracks and so destroying its insulating properties. The father of the present Lord Rayleigh used to show an experiment at the Royal Institution illustrating this effect. A sheet of stretched rubber was put several feet away from the spark gap of an induction coil which was then started working. After a few seconds, a hole appeared in the stretched rubber which rapidly increased in size. It will be seen that it is necessary when working with the coronal and brush discharges which appear at high voltages to shield rubber cables. In the *Electrician* of February 22, the method of testing cables used by the German Aircraft Research Establishment to see the effects of the action of ozone is described. It appears that the ignition cables of aeroplane engines have to be renewed every 400 hours due to deterioration produced by ozone. In 1932 a German cable manufacturer succeeded in producing a rubber compound which was practically unaffected by ozone under normal working conditions. A cable insulated with this new compound was subjected to the action of ozone for 1,000 hours and then passed satisfactory tests. A cable insulated with ordinary rubber broke down after one hour's similar treatment. Typical examples of test pieces after breakdown are shown. It is stated that with ordinary ignition cable, corona discharge begins when the crest value of the voltage is 7,000. Under normal conditions the crest value is double this, and to prevent its formation it would be necessary to increase its diameter from 0·28 in. to 0·44 in., which would require 2·5 times as much material.

Mechanism of Salt Absorption by Plant Cells

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FEW problems in plant physiology have more general implications than that of the mechanism of salt absorption. The outstanding feature which requires explanation is the means whereby certain salts, which occur in extreme dilution in the medium bathing the cells, attain considerable concentrations in the vacuole, where they are maintained, apparently, in true solution. The obvious analogy between this process and the mechanism of secretion in the animal body is alone adequate justification for again directing attention to this question.

In recent years there have been many physicochemical speculations which suggest devices whereby living plant cells might evade those simple equilibrium conditions which they rapidly approach after death or injury. The tendency has been to stress mainly the properties (real or hypothetical) of the functional membranes, and to pay but scant attention to the metabolic activities of the living system. One of the most prominent of such theories is still that of Osterhout[1,2]. The principal features of this view and those relevant to this discussion are as follows:

(1) The functional protoplasmic membranes are fluid, lipoidal and non-dissociating.

(2) Salts enter principally, if not exclusively, as undissociated molecules. Cations penetrate only in association with hydroxyl in the form of undissociated free base.

(3) The gradient of 'thermodynamic potential' of free base ($[K] \times [OH]$, $[Na] \times [OH]$) determines the rate and direction of movement of K and Na respectively.

The theory is largely based upon experiments with the marine cœnocytic green alga, *Valonia macrophysa*, which, like the closely related form *Valonia ventricosa*, occurs in warm seas under highly specialised conditions of light, temperature and aeration.

V. macrophysa occurs at Bermuda and has been investigated mainly in winter, whereas both species are found at Tortugas, either in the specialised environment provided by the moat of Fort Jefferson (mainly *V. macrophysa*) or on the open reef (*V. ventricosa*). The Tortugas material has been examined in the summer months and the criticism has been raised by the workers at Bermuda that it is not 'healthy' at this season. This is not borne out by my own experience, especially in the case of *V. ventricosa*, which is on morphological grounds the most useful species.

In recent years the theoretical views have also been developed by experiments on 'models'[3,4] purporting to represent the living cell, on the implicit assumption that the fundamental postulates are correct. In the light of recent work, one may query this from two points of view, namely:

(1) That the theory is not an adequate explanation even for the special case of *Valonia*.

(2) That it exploits unduly the peculiar features of *Valonia* and its environment in a manner which could not possibly apply to plant cells in general.

Until recently[5], the direct evidence for the theory has rested largely upon experiments in which the *internal* reaction of *Valonia* was modified by the penetration of ammonium hydroxide from ammonium chloride - sea-water[6]. Granted that the theory accounts qualitatively for the *direction* of the subsequent movement of potassium and sodium ions (K out, Na in) it is evident that it cannot account for rates. Contrary to expectations, sodium enters in presence of ammonium chloride much faster than in normal sea water. Furthermore, in this experiment, *one of the most significant of those which test the theory on living cells*, rather than models, the observed change in sap composition is in the direction of attainment of equality of concentration between sap and external solution. Consequently, potassium and sodium ions each moved *with*, rather than against, the prevalent gradients, not only of potassium hydroxide and sodium hydroxide but also of the respective ions. The crucial test of the theory is its ability to explain and foretell movements in the *reverse* direction. Despite attempts to evade this objection (see ref. 6, p. 310), it seems that the more probable explanation is that the ammonium hydroxide produced changes for which injury is the only, but unsatisfactory, designation. That ammonium chloride in the concentrations employed has such irreversible effects upon *both* species of *Valonia* (*V. macrophysa* and *ventricosa*) as they occur at Tortugas is now quite evident[8,9]. Unless differences between the Tortugas and Bermuda types of *V. macrophysa* without morphological or taxonomic basis are postulated, it is difficult to believe that such did not apply in the earlier experiments of Osterhout[6]. This is in fact indicated, since some cells were actually so far from normal that they died, and considerable corrections were necessary in the volume data of the ammonium chloride series (see ref. 6, pp. 308, 309). In the light of this the evidence that the remainder were completely uninjured is not convincing.

Recent experiments[10] with potato tissue which imitated the essential features of the above *Valonia* experiments have shown that the effect of ammonium penetration from ammonium salts is to reduce the capacity for the accumulation of *all ions*, namely (K, Na, Cl, Br, phosphate), and this is reflected in decreased water absorption. This occurred although considerable internal concentrations of ammonium produced only a *small change* of internal *p*H in the more strongly buffered cell sap of potato. The penetration of ammonium seems to depress the accumulation mechanism. Any other superimposed effects were readily interpreted as simple exchanges involving cations.

Experiments involving ammonium chloride solutions are therefore but a dubious proof of the theory of Osterhout, although from the prominence given to them[1,2] they are apparently regarded as its best confirmation.

The theory in question also demands that changes in external reaction, as well as internal, should affect the distribution of potassium and sodium ions between sap and sea water. Considerable prominence has been given to the fact that an external *p*H of 5·5, which causes irreversible injury and death, also induces loss of potassium ions. For reasons already stated, this has little or no value as a confirmation of the mechanism of *accumulation*. Jacques and Osterhout[7] also claim that a recent examination of the effects of external reaction substantiates the theory. It is again apparent that very small concentration changes have been transformed by using volume data to what appear to be considerable differences of *total amount*. In other words, there is no evidence that the internal *concentration* of potassium ions is a function of external *p*H, but rather to the contrary. If the external *p*H really does determine the growth of the cells and hence the total salt content, this is not necessarily a proof of the suggested mechanism of entry and accumulation of potassium ions, but merely another indication of the connexion between the processes of growth and metabolism and that of salt absorption. Unfortunately, the most significant data refer to experiments in the light, where there is considerable uncertainty as to the exact *p*H which prevailed and the nature and extent of its drift[5]. The apparently large magnitude of the suggested difference in absorption of potassium ions (see ref. 5, Fig. 1), which is attributed to the small difference in *p*H between two cultures (one of *p*H 8·8 and the other which "started at 8·2 and rose somewhat but apparently not as high as the other"), strongly suggests to me that some other variable and not the concentration of hydroxyl ions was really the determining factor in this case. This is the more probable when one recalls that, though this organism in its normal habitat may withstand considerable fluctuations (diurnal and otherwise) of certain factors (oxygen concentration, external *p*H, etc.), yet in its growth and distribution it is clearly limited by subtle differences not easy to specify completely. This has been impressed upon me by observations in the moat of Fort Jefferson at Tortugas. Attempts to demonstrate the effect of external *p*H upon the absorption of potassium ions by *Valonia macrophysa* in the dark were inconclusive. One of the reasons suggested may be incorrect since, contrary to the statement that it lacks carbohydrate, *Valonia* may be abundantly supplied with small starch grains[11].

Fortunately, quite apart from its ability to grow conspicuously, *Valonia ventricosa* (not available at Bermuda) will absorb potassium from sea water enriched with potassium chloride either in the dark or the light. External *p*H's ranging from 9·0 to 5·5 may be produced and maintained by control of the carbon dioxide tension. Under these conditions, it is now apparent[8,12] that an approximately threefold increase of external concentration of potassium ions can produce a definitely significant gain by the cells both of concentration and total amount, and this is but slightly affected by an external *p*H range from 9·0 to a reaction only slightly more alkaline than 5·5. Moreover, a slight but significant maximum occurred not at *p*H 9·0 (as the theory referred to would demand) but at approximately *p*H 7·0. The theory of 'thermodynamic potentials of free base' demands that the tendency for potassium entry, measured by the value of the product [K] × [OH] for external surroundings should be determined equally by the concentration of the potassium and hydroxyl ions. It appears, therefore, that entry of potassium is more closely related to the potassium ion concentration than the hypothetical [KOH]. Similarly, when sea-water is enriched with sodium chloride, some gain of potassium may be observed, which also suggests a closer relation between potassium absorption and [Cl] than [OH], since the [KOH] remained undisturbed[12].

It is submitted that these facts are in accord with other views which show that the rôle of *p*H is not the dominant one which the theory suggests. Hoagland[13], using both *Nitella* and the roots of barley, has shown repeatedly that they can accumulate both ions (for example, potassium and bromide) from solutions more acid than the vacuole. Similarly, I have stressed that the existing *p*H gradients could not explain the behaviour of storage tissues, which accumulate salts from solutions almost identical in reaction with their cell sap. Such facts controvert the theory of Osterhout. In view of its dubious utility in the interpretation of the special case of *Valonia* and the abundant evidence to the contrary, especially where more active systems are concerned, there seems to be little justification for continued emphasis upon the idea that cations (particularly potassium and sodium) penetrate cells in general only in the form of undissociated free base.

The experiments at Tortugas, already referred to, suggest that the obscurity which surrounds the manner of growth of *Valonia* and the extremely low level of its metabolic activity more than outweigh its apparent morphological advantages. That the latter are more apparent than real is suggested by even a casual experience with these organisms. It is an interesting anomaly, both morphologically and physiologically, rather than a typical case from which generalisations may be drawn safely. To my mind, *Valonia* finds its parallel with cells like red blood cells or those storage tissues which have permanently ceased active growth and synthesis, rather than the more vigorously metabolising plant cells like those of rapidly growing roots or certain storage tissues[7] which display greater capacity for salt absorption. In the latter cases, it is still difficult to avoid the view that cells do osmotic work in the simultaneous absorption of both anions and cations by virtue of their metabolism and capacity to grow. Nor does the rôle of growth merely involve cellulose synthesis and wall extension, but rather is the ability for salt accumulation inherently a property of cells still capable of constructive protein metabolism and a turnover of carbohydrate far in excess of that involved in mere cellulose synthesis. Thin discs of potato tissue in dilute aerated solutions of potassium salts may metabolise carbohydrate equivalent to 4·27 kgm. cal. per 45 gm. fresh weight in three days. This is equivalent approximately to one sixth of their original total heat value, and most of this decrease in total energy may be due to heat production. Whether a fraction not yet accounted for is more specifically associated with accumulation of salts is a problem at present under investigation.

Whatever the rôle of carbohydrate metabolism may prove to be, it is difficult to follow Osterhout so far as to believe that, if the necessary metabolic activity were available, the still extensible walls of *Valonia* could not be distended without cellulose synthesis, so that further increment of salt *concentration* (without corresponding water absorption) could be accommodated by an increase of wall pressure. Despite even the evidence of slow cell extension[5] in the recent Bermuda experiments, it seems that the large cells of *Valonia* as commonly used retain the essential properties only in relatively slight degree. Consequently, the rôle of respiration and metabolism as a potential source of energy has been minimised and the chief stress laid upon its possible effect as a determinant of internal reactions. The theoretical manipulations of ionic products (for example, [K] × [OH]; [Na] × [OH]) are based essentially on equilibrium criteria and create the illusion that rapid metabolism and energy exchanges are unnecessary for salt accumulation *per se*. It is in these operations that undue weight seems to have been given to certain special features, not applicable to cells in general, of what is after all an obscure organism

Lastly, there seems grave danger that the admittedly ingenious and extensive work devoted to models[3] may divert attention from the fundamental facts that, not only are they far removed from physiological reality, but also that the very principles upon which they are based are such that judgment must be reserved concerning their applicability to the general problem of salt absorption *in vivo*

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[1] Osterhout, W J V, *Biol Rev*, **6**, 369, 1931

[2] Osterhout, W J V, *Ergeb Phys und exp Pharm*, **35**, 967, 1933.

[3] Osterhout *et al*, numerous papers in *J Gen Physiol*, **16** and **17**

[4] Osterhout, W J V, and Stanley, W M, *J Gen Physiol*, **15**, 667, 1931-32

[5] Jacques, A G, and Osterhout, W J V, *J Gen Physiol*, **17**, 727, 1934

[6] Jacques, A G, and Osterhout, W J V, *J Gen Physiol*, **14**, 301, 1930

[7] Berry, W E, and Steward, F C, *Ann Bot*, **48**, 395, 1933

[8] Steward, F C, and Martin, J C, Carn Inst Wash Yearbook, 33, 1934

[9] Blinks (private communication from W J V Osterhout) reports that ammonium in low concentration causes the formation of spores (the so-called aplano spores) by aggregation of the protoplasm As far as the parent cell is concerned, this represents an irreversible change which is frequently caused by injury—mechanical and otherwise—as emphasised by recent experiments of Kopac at Tortugas (see Carnegie Yearbook, 1933)

[10] Steward, F C, unpublished data

[11] Doyle, Wm L, Contrib from Tortugas Lab (In press)

[12] Steward, F C, Carn Inst Wash Yearbook, 32 281, 1933

[13] Hoagland, D R, Symposium on Salt Absorption, A A A S Berkeley, Cal, 1934

[14] Steward, F C, Wright, R, and Berry, W E, *Protoplasma*, **16**, 576, 1932

[15] Steward, F C, *Protoplasma*, **17**, 436, 1932 **18**, 208, 1933

Conference on Industrial Physics

THE first Conference on Industrial Physics to be held in Great Britain took place in Manchester under the auspices of the Institute of Physics on March 28–30 The subject chosen for the Conference was "Vacuum Devices in Research and Industry", and its chief object was to direct attention to the important part which physics and physicists can and do play in modern industrial life Nearly six hundred people registered as members of the Conference, of which about a hundred were members of the Institute The majority of the others were engaged in Government and industrial research laboratories and works, some coming from a considerable distance to attend the meetings The outstanding success of this new venture of the Institute of Physics has demonstrated beyond all possible doubt that there exists a very large number of men who are engaged in applying physics to the solution of industrial problems, in addition to many who are employing its methods for industrial work of a more routine character One of the objects of the Institute is to provide facilities for the interchange of ideas among those engaged on industrial physics problems by means of meetings and special journals Many propositions towards the achievement of these objects will doubtless come to earlier fruition as a direct result of this Conference

The sessions were held in the University of Manchester. The Conference was formally opened by Sir William Clare Lees and the Vice-Chancellor, and was presided over by Prof W L Bragg The lectures were all informal in character, and consequently they are not being published, each lecture was followed by a useful discussion The titles and lecturers were as follows "Modern Electrical Illuminating Devices" by Mr J. W. Ryde, of the General Electric Co Ltd, "Applications of Photocells" by Mr. T M. C Lance, of Messrs. Baird Television Ltd, and Mr. R C Walker, of the General Electric Co Ltd, "The Cathode Ray Oscillograph in Research and Industry" by Mr L. H Bedford, of Messrs A C Cossor Ltd; "Recent Applications of Mercury Vapour Rectifiers and Thyratrons" by Mr L J Davies and Mr. A L. Whiteley, of the British Thomson-Houston Co Ltd, "High Tension Vacuum Tube Devices in Research and Industry" by Dr J. D. Cockcroft, of the Cavendish Laboratory, Cambridge; "X-rays in Industry" by Dr. G Shearer, of the National Physical Laboratory It was interesting to record that, almost without exception, those who took a leading part in the various activities of the Conference, including the lecturers, were quite young men The Organising Committee also received considerable commendation for its care in the selection of the lecturers, who were in each instance associated with industrial practice, the Committee preferred to extend the invitations to lecture to such men rather than to distinguished pioneers of the devices who, it was felt, would be more familiar with them in the laboratory stage, as distinct from their adaptation for industrial purposes

On March 29 the members of the Conference spent the afternoon at the research laboratories and works of Messrs Metropolitan-Vickers Electrical Co Ltd, and the next day visits were paid to the Shirley Institute of the British Cotton Industry Research Association, and to the Post Office Telephones

An exhibition of apparatus, instruments and books cognate to the subject of the Conference was held in the laboratories of the University, in which twenty firms and research organisations took part, and in addition some of the important work which is being carried on in the physical laboratories of the University was demonstrated A special section intended to exemplify the multifarious uses and utilitarian value of vacuum devices was a feature of the exhibition, and aroused great interest The specific function of the whole exhibition was to demonstrate that apparatus such as the cathode ray tube and the photocell, for example, are now utilised in devices which are practically fool-proof and can be used as tools in all manner of manufacturing processes Unlike other exhibitions, it was not so much concerned with demonstrating the underlying physical principles of instruments or details of their mechanism, but rather with the fact that the devices shown were not mere scientific toys that had been brought from the laboratory and disguised, but that these devices were real and necessary industrial tools, which the more enterprising manufacturers are already employing A limited number of copies of the catalogue of the exhibition is still available from the Institute of Physics, London, S W 7 (1*s* 3*d* post free)

On Saturday morning some 65 parties from local schools visited the exhibition, and in the afternoon and evening it was thrown open to the public It is estimated that 3,500 people visited the exhibition during the three days

Prof W L Bragg broadcast a talk about the

Conference and exhibition on the evening of March 29 and it also received considerable attention from the Press. On Friday evening, March 29, Mr. R. A. Watson Watt delivered a public lecture, which was attended by about 350 people, on "Cathode Ray Tubes in Industry". The lecture was given in the Great Hall of the College of Technology. It is hoped, in these ways, to bring to the notice of all, the great possibilities of existing inventions and scientific knowledge of a physical character, and the important part which these play in everyday life.

The social events included a Conference dinner in the College of Technology, at which Sir Henry G. Lyons, the president of the Institute, presided, and the guests included the Lord Mayor and the Lady Mayoress of Manchester, and a number of other distinguished persons.

The great success of this Conference renders it likely that similar conferences will be held from time to time in the future. Apart from the value of the information gained from the various lectures and discussions, as well as from the exhibition and the visits, the contacts made between physicists and those concerned with the technical developments of industry cannot but prove a fruitful source of lasting mutual benefit.

HERBERT R. LANG

University Education

THE inaugural address of the president of the Royal Statistical Society, Prof. M. Greenwood, delivered on November 20, 1934, contained many points of interest concerning the past history and probable future of the universities of Great Britain (*J. Roy. Statistical Soc.*, 98, 1-37, 1935).

By consideration of birth-rates, there should be a decline in numbers at the universities in 1935-36, a recovery in 1938-9, and then, unless there is a change of policy, a steady decline. The present entrance requirements are not unduly severe; in fact, if we adopt the view of some university teachers, that failure to obtain first or second class honours shows unsuitability for university training, more than fifty per cent of the unassisted students should have been excluded, and also 10-25 per cent of those assisted by scholarships and similar benefactions. Dr. A. Flexner, who considers that a university suitable for the present and future of the world should be concerned with the conservation and interpretation of knowledge and ideas, the search for truth, and the training of students, concedes that Oxford and Cambridge have touched the fringe of these ideals, but he finds it impossible to give even this faint praise to any other English university, least of all to London. Mr. H. G. Wells doubts whether the universities and the conceptions of education they embody are destined to any very prolonged predominance over the intellectual processes of mankind, and considers the ordinary arts course in our older universities to be "merely a wasteful prolongation of puerility". Even Dr. H. Rashdall, who cannot be accused of prejudice against the ancient universities, observes that "Universities have often had the effect of prolonging and stereotyping ideas and modes of thought for a century or more after the rest of the world has given them up".

However, Prof. Greenwood considers that Dr. Flexner's ideals are too narrow, and are capable of realisation only in small and cloistered communities like Oxford and Cambridge. For large cities such as London, he considers that the loss of intimacy may be compensated by a gain in continuity, and that requirements should be made less rigid, so as to have no chasms between matriculated and non-matriculated students, or between graduates and non-graduates. In the past, one supported education largely on the ground that an educated nation would be better fitted to secure advantages in the international struggle for markets. But there has been a fundamental change in economic conditions. Now that productive man power is in excess of demand, and millions of man-hours are running to waste, higher education should be considered, not for the material or social advantage it confers, but as a path to happiness.

In the discussion that followed the address, Mr. Udny Yule deprecated some of the sterner judgments on the University of London, and suggested that it differs from the older universities in degree rather than in kind. The research worker is the evolutionary successor of the hunter and is not a being apart, stripped of emotion, an intellectual machine. On this view we can understand his psychology, his blunders, his emotions. In fact, it is impossible to draw a sharp line between the investigations of a detective and those of the best type of fellow of the Royal Society. Even a poor piece of investigation may have taught much to the investigator himself, and have given him many happy hours.

University and Educational Intelligence

LONDON.—Dr. John Gray, since 1934 director of pathology and Lyle research scholar at Queen Mary's Hospital for the East End, has been appointed reader in morbid anatomy at the British Postgraduate Medical School, as from April 1.

On his retirement from the professorship of surgery at St. Bartholomew's Hospital Medical College at the end of the present session, the title of emeritus professor in surgery in the University will be conferred on Prof. G. E. Gask.

The Senate has approved a proposal to hold the School Examinations (General School and Higher School) overseas in and after 1936.

ST. ANDREWS.—The Senatus Academicus has resolved to confer honorary degrees on the following, among others: *LL.D.*, the Right Hon. Lord Alness; Andrew Bennett, secretary of the University since 1903, and secretary of the Scottish Universities Entrance Board; Prof. C. H. Browning, Gardiner professor of bacteriology in the University of Glasgow; Prof. A. H. Gibson, Beyer professor of engineering and director of the Whitworth Laboratories in the Victoria University of Manchester; Sir John Boyd Orr, director of the Rowett Institute, Aberdeen.

THE Fifth Quinquennial Congress of Universities of the Empire, organised by the Universities Bureau of the British Empire, will be held at Cambridge on July 13-17, 1936.

UNIVERSITY education in the United States is breaking free from the traditional system of semester-hour credits with compulsory class attendance and teaching by textbooks. More than a hundred universities and colleges have, says Dr. McNeely of the Federal Office of Education in a paper contributed to *School and Society*, adopted in varying degrees devices for substituting voluntary learning on the part of the student for external compulsion. Among the leaders are the University of Chicago, Harvard, Cornell and Buffalo Universities and Swarthmore and Goucher Colleges.

OF German professors expatriated owing to Nazi intolerance, thirty four have, it appears, migrated to the United States, and sixteen of them have been assigned to various universities by an "Emergency Committee in Aid of Displaced German Scholars". The remainder have combined in New York to form under the leadership of Dr. Alvin Johnson, director of the New School for Social Research, an association known as "The University in Exile". An article in *School and Society* of February 23 announces the appointment of a permanent board of trustees for the association. The association aims at perpetuating "the free German culture, which it had become traditional that post graduate students from America and all over the world should seek, as a complement *to the facilities of their own lands*": the words are quoted from a statement by the chairman of the board, Mr. I. A. Hirschmann.

THE Royal Institute of Science, Bombay, which began teaching work in 1920, has recently issued a report (Bombay: Government Central Press, pp. 74, gratis) covering the period 1926–34. The declared policy of the Institute has been: (1) to interest the public by popular lectures and demonstrations, (2) to qualify undergraduates for scientific investigation, (3) to provide the means for carrying out original work, to guide beginners in research and to co-operate, on occasion, with other scientific institutions and assist industry by investigating industrial problems. The staff comprises, in addition to the principal, Dr. T. S. Wheeler, sometime senior research chemist with Imperial Chemical Industries, Ltd., eighteen professors, lecturers and demonstrators in chemistry, physics, botany, zoology and mathematics. The students, excluding courses in physics for first-year arts students, number about 300 and the annual cost of their education is Rupees 608 per student. There has been in the past ten years a steady increase from 26 (being 15 per cent of all full-time students) to 91 (31 per cent) in the number of post-graduate students. Progress in developing the Institute's research activities is further indicated in a list of 128 papers published and abstracts of 101 researches in progress. Both staff and students are, the report says, keen on their work, and the library and laboratories are open until late in the evening, even during vacations. A frontispiece to the report gives a view of the impressive façade, 400 yards long, of the Institute building, a wing of which was handed over in November 1933 to the University of Bombay to house the new University Department of Chemical Technology.

Science News a Century Ago

Monument to Telford

In *The Times* for Tuesday, April 7, 1835, it was stated that "At a general meeting of the Dundee Harbour Trustees on Wednesday last, it was moved by Mr. David Baxter that the harbour trustees do subscribe 10 guineas to the general subscription in London for a monument to the memory of Thomas Telford, Esq., Engineer, to be erected in Westminster Abbey, in consideration of the valuable services rendered by that distinguished engineer to the harbour of Dundee, first, in giving the very excellent plan for the construction of the first wet dock now called King William's dock; 2nd, in the valuable professional and practical advice which he gave for carrying the work into effect; 3rd, in procuring from Government, by the Exchequer Loan Commissioners, at a time when the erection of the harbour was considered to be a work of speculation, a loan of the sum of £30,000 (nearly all this has since been repaid); and lastly for giving his able assistance in carrying the perpetual bill of 1830 through Parliament, which has placed the harbour establishment in a situation that has made it at once the cheapest and one of the most improved harbours in this kingdom".

Lardner on Halley's Comet

On April 10, 1835, Lardner gave the first of two lectures on Halley's comet at the Royal Institution. In the course of his lecture, he said that in 1757 Lalande proposed to Clairaut the calculation of Halley's comet, which was expected to return shortly. They were assisted by a French lady, the wife of a chronometer maker. The calculation was enormous, because the orbit must be divided into degrees, and each degree required as great a calculation as the whole orbit. They tell us, he said, that they were employed from morning to night, not excepting meal hours, incessantly for six months in this computation. Clairaut was so nervous that he hurried his calculations before the Institute. "Although Clairaut was not quite correct to the day, the only wonder was, that he should have been so accurate, for as he said, when a body traverses a space of 1,500,000,000 miles beyond our sphere of observation, how do we know but that some other planet may act upon it, and influence its course. In 25 years the planet Herschel was discovered, which it was proved, did actually operate in producing the effect which Clairaut had surmised."

Railways in France

According to the *Mechanics' Magazine* for April 11, 1835, the French Minister, M. Thiers, had just presented to the Chamber of Deputies "a project of law relating to railroads. He announced that the Government engineers had fixed upon three principal lines for railroads—one from Paris to Havre, via St. Denis, Pontoise, and Gisors, with branch lines to Rouen and Dieppe; a second from Paris to Lyons and Marseilles; and a third from Paris to Lille, Bourdeaux and Strasbourg. Surveys have it appears been made, and plans drawn out for these three several lines; but one only, that from Paris to Havre, is recommended to be at first undertaken. It is proposed to throw open the work to public competition, and to entrust it to any company who will offer the best conditions, and sufficient securities". A fortnight later the *Mechanics' Magazine* said that there were in operation in France railroads from St. Etienne to the Loire (thirteen miles), St. Etienne to Lyons (thirty-seven miles) and Andrezieux to Roane (forty two miles), while two other lines under construction ran from Alais to Beaucaire (forty-three miles) and from Epiney to the Canal of Burgundy (seventeen miles).

Societies and Academies

Edinburgh

Royal Society, March 4 A. M **Cockburn**: The geology of St. Kilda. The islands of the St. Kilda group appear to represent the peripheral relics of a larger complex of intrusive igneous rocks perhaps some seven miles in diameter The intrusions are sheet-like and, in order of age, consist of gabbros (including olivine eucrite), coarse- and fine grained dolerites, basalts and three granophyres. On St Kilda these masses, the eucrite excepted, are inclined outwards from the supposed centre of intrusion, suggesting ring dyke structure A very abundant series of variously dated, *thin, gently inclined sheets* are suggestive of cone intrusion. Arcuate structure, however, has not been observed in the field owing to the fragmentary nature of the exposures J. L. **Bhaduri** The anatomy of the adhesive apparatus in the tadpoles of *Rana afghana*, Gunther, with special reference to the adaptive modifications A *histological description of the cement organs* is given and attention is directed to the 'brush-border' fringing the gland cells The muscles of the disc are described and their homologies discussed The diaphragm is shown to be modified, not only has it a thickened tendinous ridge in its central part, but in addition it possesses two distinct apertures for the passage of the diaphragmatobranchialis medialis muscles An account of the histology of the skin of the disc is given The cornification, and *later* tuberculation, of the posterior region of the disc is shown to be correlated with the habits and habitats of the tadpoles The rim of the sucking disc encloses a lymph space which is considered to be another adaptive modification for counteracting the pressure of the rushing current A C **Aitken**: Least squares and linear *combination of observations* The paper deals with the equivalence, in practical outcome, of two different approaches to least squares, one based on the assumption that errors are normally distributed in such a way as to give the observations the greatest probability, the other on the postulate that the values to be adopted should be weighted means of the observations, with smallest standard error Dr W. F. Sheppard had proved this equivalence for representation by polynomial curves The present paper confirms it for general functional representation, as well as for the case of correlated errors

Paris

Academy of Sciences, February 18 (*C R*, **200**, 597–700) L **Lecornu** The return in space. **Jules Drach**. Logical integration and the transformation *of the equations of dynamics with two variables* Conservative forces Cubic integrals H **Deslandres**. A simple and general relation of the molecular spectrum with electrons and rings of electrons of constituent atoms J **Haag** The mathematical theory of mechanical and electrical filters. **Louis Roy**: The deformation of an elastic line round one of its points. **Jean Baptiste Senderens**: The catalytic decomposition of monochlor fatty derivatives. Study of the decomposition of normal butyl chloride, normal propyl chloride and isopropyl chloride with various catalysts. All the catalysts, with the exception of active carbon, cause splitting up into hydrochloric acid and the corresponding olefine **Šmidov** and **Verčenko**: Some geometric properties of ensembles. W **Brecka** Multiply monotone polynomials which diverge the least from zero, the two first coefficients being given **Soula** An interpretation *of Picard's theorem on integral equations* J **Rey Pastor**. Series of integrals of successive orders of a function. **Jean Delsarte**. A general principle of development of functions of a real variable in series of integral functions **Nicolas Cioranesco**. The development of an analytical function of an analytical function and on some consequences **Julius Wolff** *The representation of a demi-plane* on a demi-plane with an infinity of circular incisions **Edouard Lainé** Kinetic moment and dynamic moment **Georges Bouligand** Some processes of partial determinism **Miroslav Nénadovitch** The corrections to be applied to the aerodynamic characteristics of a biplane cell under experiment in an air blast with guided or free circular vein **Emile Merlin** Two inequalities and the flattening of an equilibrium figure of a homogeneous fluid in rotation round a fixed axis **Combier** and **Poidebard** Contribution to the study of sand storms The photography of sand storms P **Lejay** Observations of the intensity of gravity in the Philippines, the Malay Archipelago and the Dutch Indies **Emile Sevin** Waves, spin and numbers **Maurice Lévy**. Selective *transformations* The *properties of transformation* curves and selectivity curves **Georges Dèchene** The electrical resistances at the contact of two semiconducting substances The results described resemble those obtained when a semiconducting substance is in contact with a metal, and can be interpreted in the same way **Pierre Jolibois** The chemical equilibrium in tubes containing rarefied gas in the neighbourhood of the cathode and in the positive column Study of the dissociation of carbon dioxide in a Geissler tube, arranged so that gas circulates in a closed system **Mme Lucie Lefebvre** The absorption spectrum of ozone at a low temperature The absorption spectrum of ozone in the visible region (4400 A–6500 A) cooled to about −80° C is identical with that at the ordinary temperature This does not accord with the results of Chappuis published in 1882. **Antoine Goldet** The thermal variation of the magnetic double refraction and molecular electrical electric moments **Louis Henry** The photo-chemical decomposition of nitrous oxide and the energy of dissociation of nitrogen. The energy of dissociation of the nitrogen molecule into two *normal atoms* has a lower value than that deduced by Dutta (200,400 cal) It lies between 158,000 and 169,000 cal. **André Boullé** Study by means of X-rays of the anhydrous sodium metaphosphates **Wojciech Swietosławski** and **Ignace Żlotowski**: A method of measuring the heat evolved by the absorption of γ-radiation The apparatus described and illustrated, which is a modification of the calorimeter described by Swietosławski and Bartoszewicz, is capable of measuring the heat evolved by γ-radiation within two or three per cent **Paul Demougin**: The absorption of iodine vapour by activated carbon and by silica gel The quantities of iodine vapour absorbed in the neighbourhood of the saturation pressure for a given specimen of carbon do not vary with the temperature, whether the temperature is above or below the melting point of iodine. The quantities are proportional to the absorptive powers for other vapours, such as ether **Gustave Ribaud** and **Anatollah Rochan Zaer** The calculation of flame temperatures. **Georges Fouretier**: The direct measurement of low pressures of saturated vapours Guy Gire and François Puche. The thermal decomposition of the chlororhodates Jean Amiel The complex compounds formed by cupric perchlorate and cupric bromate with some primary amines Charles Courtot and Alfred Baron. Contribution to the study of the halogenation of wool Joseph Wiemann. The hydrogenation of a mixture of two α-ethylenic aldehydes Paul Gaubert · Anisotropic liquids Rapid evaporation of solutions of methylene blue or of neutral red gives liquid residues showing double refraction Edgar Aubert de La Rue The first results of a geological expedition to the New Hebrides Paul Jodot The presence at Favorelles (Loiret) of a small horst in the middle of the large crushed vault, between the fault systems of Cosne and Sancerre Albert Robaux The existence of the upper Eocene and the Oligocene in the Flysch series of the south of the province of Cadiz Jean Marcais Concerning a deposit of fossiliferous Trias in the eastern Rif Giorgi An observation of globular lightning Louis Genevois and Michel Pavloff Researches on the fermentable sugars of wheat flour Mme Jeanne Bouxin and René Legendre Cephalopods of the genus *Vitreledonella* in the stomachs of germons found in the Bay of Biscay Raymond-Hamet The action of corynanthine on the penial circulation of the dog Marcel Badouin Six cases of thoradelphy in the pig and sheep W Sarnowiec : The allergic reaction in acute infections

Brussels

Royal Academy (*Bull Classe Sci*, **30**, No 12) L Godeaux Involutions of the second order of space (5) J Ledrut Production of hypoglycæmia by intraduodenal injection of dilute hydrochloric acid in *Raia clavata*. The injection causes a drop in the blood sugar, and the effects appear to be the same as in the dog J Géhéniau Parametric form of a *n*-ple integral E Lahaye · A class of differential equations of the first order possessing a singular point J Thibaud Penetrating radiation produced in beryllium by bombardment with α rays The absorption curve of a neutron beam in lead, iron, bismuth and paraffin wax shows a series of maxima and minima. Possible conclusions from the observations are considered. M. de Hemptinne and J. Wouters · Raman spectrum of silicomethane. Liquid silicomethane shows Raman lines of which $\Delta\nu$ is 2,166 cm^{-1} and 958 cm^{-1} A De Waele : Note on the evagination of *Cysticercus fasciolaris*, Rud. L Godeaux · Algebraic surfaces of genus zero having elliptic tricanonical curves. Th. De Donder. A new generalisation of the wave mechanical equation An extension of a previous generalisation of Schrödinger's equation to take electron spin into account A. Delgleize. Minimal surfaces and their transformations. Yvonne Dupont Polarisation currents The fictitious currents due to the electro-magnetic polarisation are defined J. Géhéniau. The theorem of momentum and energy in a gravitational field. J.-M. Delfosse : Raman spectrum of phosphoretted hydrogen. The principal Raman line, $\Delta\nu = 2306$, agrees well with that found by Fung and Barker in the infra-red spectrum, $\nu = 2327$, allowing for change of frequency from liquid to gaseous state. L. Lison : On the phenomena of metachromatism (2) Spectrophotometric study of metachromatic dyes It is shown that none of the present theories can account for the change of colour of a metachromatic dye by a chromotropic substance, hydrolytic action and tautomerism being inadequate J Bordet Specificity in biology G. Lemaître The expanding universe

Washington, D C

National Academy of Sciences (*Proc*, **21**, 1-68, Jan. 15, 1935) William King Gregory On the evolution of the skulls of vertebrates with special reference to heritable changes in proportional diameters (anisomerism) When local acceleration or retardation of growth rate of certain parts occurs, the process is termed anisomerism This process is traced in the most primitive known fossil chordates (Ostracoderms) It is concluded that *Poraspis* and *Palæaspis* are the most primitive The existing cyclostome orders, petromyzonts and myxinoids, show morphological evidence of an ostracoderm ancestry, while *Amphioxus* is a much degraded anaspid ostracoderm Emmett Reid Dunn The snakes of the genus *Ninia* These Colubrid snakes occur in Panama, Costa Rica and Nicaragua, and seem to come between a group of burrowing forms and a group of arboreal forms Froelich G Rainey A new prehistoric culture in Puerto Rico Excavations of middens at three widely separated sites have revealed two or possibly three culture horizons, (3) doubtful recent, (2) Arawak, (1) crab culture, respectively The latter is new, and is characterised by the use of painted decoration on well-fired vessels of fine grained clay, generally with negative designs formed in red and outlined in white paint H J Muller and A A Prokofyeva The individual gene in relation to the chromomere and the chromosome A selected lot of chromosome breaks in close proximity with one another produced by irradiation in *Drosophila* was analysed Mutually consistent genetic and cytological results were obtained, and maps showing the positions of genes and breaks within a portion of one large chromomere have been made Apparent 'mutational' changes accompanying gene rearrangements are due to the influence of neighbouring genes, and this position effect can extend over several genes The total number of genes in the chromatin of a *Drosophila* salivary gland nucleus is 5,000 10,000 (See also Nature, Feb 16, 1935, p 253) Robert W Wilson Cricetine-like rodents from the Sespo Eocene of California. William Bowie Fundamental geodetic surveys in the United States nearing completion The U.S Coast and Geodetic Survey is now completing a series of first-order arcs of triangulation and lines of levels spaced at intervals of about 100 miles, with second-order triangulation and levelling in the intermediate areas It has been found that mean sea-level along the coast is not an equipotential surface, but increases with increase in latitude The Canadian and Mexican Governments have unified their triangulation systems with that of the United States, so a single triangulation not is available for the whole of North America Richard J Lougee · Time measurements of an ice re advance at Littleton, N.H. The data afforded by sections, showing sands and varved clays between an upper and lower till, exposed during the construction of a dam, make it possible to follow the retreat, re-advance and final retreat of the ice at this locality G A Miller (1) Groups involving a set of as many conjugates as commutators. (2) Sets of group elements involving only products of more than *n* C G Suits The temperature of the copper arc. A condensed discharge between an electrode within the arc and the cathode of the arc is used as a source of sound The sound receiver is a non oscillatory spark discharge, the voltage of which changes abruptly when a sound wave is received , the change is recorded by an oscillograph Time intervals recorded in this way are plotted for different lengths of the arc, and from this curve the velocity, free from end corrections, is obtained as a slope From the velocity of sound in the arc, the temperature can be deduced, allowance being made for changes in density due to dissociation and in specific heats due to excitation The temperature of the copper arc is about 4,000° K to within 200 , it is very sensitive to metallic vapour content J A STRATTON Spheroidal functions These functions are defined and their properties discussed from the point of view of physical applications PHILIP M. MORSE Addition formulæ for spheroidal functions They can be used in the study of wave motion in elliptic cylinder and in spheroidal co ordinates, and in particular in dealing with diffraction problems PAUL S EPSTEIN On the bending of electromagnetic micro waves below the horizon A theoretical discussion of the transmission of radiations of wavelengths of the order of 50 cm , based on Huygen's principle The earth is regarded as a perfectly absorbing screen, and the effect of the atmosphere is neglected The formulæ derived give results qualitatively in agreement with those obtained by Marconi for radiations from Rocca di Papa on wave lengths of 50-60 cm

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, April 7

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 —M A Phillips "Fossil Reptiles" *

Monday, April 8

BRITISH MUSEUM (NATURAL HISTORY), at 11 30 —M Burton . "Diving Methods employed in Sponge Fisheries" *

VICTORIA INSTITUTE, at 4 30 - Rev Samuel M Zwemer The Origin of Religion—by Evolution or by Revelation"

Tuesday, April 9

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) —Dr P W Cunliffe "Photography in Wool Research"

Thursday, April 11

INSTITUTION OF ELECTRICAL ,ENGINEERS, at 6 —N. Ashbridge, H Bishop and B N MacLarty "The Droitwich Broadcasting Station"

Friday, April 12

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —A Fage "Aerodynamical Research and Hydraulic Practice" (Extra General Meeting).

INSTITUTION OF NAVAL ARCHITECTS, April 10-12 — Annual Meeting to be held at the Royal Society of Arts, John Street, Adelphi, W C 2

April 10, at 10 30 —Lord Stonehaven Presidential Address.

Official Publications Received

GREAT BRITAIN AND IRELAND

University College, Southampton Avon Biological Research Annual Report, 1933-34 Pp 76+4 plates (Southampton University College) 2*s* 6*d*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1620 (A 157) Abstract—Transverse Tests on Sand Cast Aluminium Alloy Bars By C E Phillips and J D Grogan Pp 2 (London H M Stationery Office) 2*d* net

The Institute of Physics Conference on Industrial Physics, Manchester, March 28th, 29th, 30th, 1935 Handbook Pp 16 Industrial Physics Conference on Vacuum Devices in Research and Industry Catalogue of the Exhibition, Manchester 1935 Pp 40+xxii (London Institute of Physics)

Liverpool Observatory and Tidal Institute Annual Report 1934 Pp 15 (Liverpool)

Proceedings of the Royal Society of Edinburgh, Session 1934-1935 Vol 55, Part 1 No 4 On Least Squares and Linear Combination of Observations By Dr A C Aitken Pp 42-48 (Edinburgh Robert Grant and Son , London Williams and Norgate, Ltd) 6*d*

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1934 (No 83) Pp 126+2 plates (Marlborough Marlborough College) Members, 3*s* , non Members 5*s*

Society of Chemical Industry Chemical Engineering Group Proceedings Vol 15 1933 Pp 136+6 plates (London Chemical Engineering Group) 10*s* 6*d*

OTHER COUNTRIES

Second Report of the Royal Institute of Science, Bombay (1926-1934) Pp ii+73 (Bombay Royal Institute of Science) Gratis

Bulletin of the National Research Council No 96 Selected Topics in Algebraic Geometry, II Supplemental Report of the Committee on Rational Transformations Pp xii+84 (Washington, D C National Academy of Sciences) 1 dollar

Sveriges Geologiska Undersökning Ser Aa, No 176 Beskrivning till kartbladet Storvik Av B Asklund och R Sandegren Pp 150+2 plates (Stockholm Sveriges Geologiska Undersökning) 4 00 kr

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Second Series (Geology), Vol 16, No 3 On the Growth Rate of Reef Corals and the Sea Water Temperature in the Japanese Islands during the latest Geological Times By Ting Ying H Ma Pp 25+4 plates (Tôkyô and Sendai Maruzen Co , Ltd)

University of Illinois Engineering Experiment Station Bulletin 269 Laboratory Tests of Three-Span Reinforced Concrete Arch Ribs on Slender Piers By Wilbur M Wilson and Ralph W Kluge Pp 122 1 dollar Bulletin No 271 Determination of Mean Specific Heats at High Temperatures of some Commercial Glasses By Prof Cullen W Parmelee and Alfred E Badger Pp 24 30 cents Bulletin No 272 The Creep and Fracture of Lead and Lead Alloys By Prof Herbert F Moore, Bernard B Betty and Curtis W Dollins Pp 50 50 cents (Urbana, Ill University of Illinois)

Sudan Government Wellcome Tropical Research Laboratories Chemical Section, Publication No 68 Report of the Government Chemist for the Year 1934 Pp 13 (Khartoum Wellcome Tropical Research Laboratories)

Government of India Department of Industries and Labour Functions and Organisation of the India Meteorological Department, 1935 Pp 25 (Simla Government of India Press)

New York Academy of Sciences Scientific Survey of Porto Rico and the Virgin Islands Vol 15, Part 2 Crustacea Macrura and Anomura of Porto Rico and the Virgin Islands, by Waldo L Schmitt , The Amphipods of Porto Rico and the Virgin Islands, by Clarence R Shoemaker Pp 125-262+4 plates (New York New York Academy of Sciences) 2 dollars

A Manual on the Air Seasoning of Indian Timbers By Dr S N Kapur Pp vii+113+11 plates (Delhi Manager of Publications) 3 rupees 5*s* 3*d*

Annual Report of the Patna Science College Philosophical Society for the Session 1933-34 Pp 5 Bulletin of the Patna Science College Philosophical Society No 5 Dr K S Caldwell Commemoration Number Pp iv+71 (Patna Patna Science College)

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser Serie Hydrografi, Bind 3, Nr 1 Temperaturmessung mit elektrischem Widerstandsthermometer auf der Kattegatsexpedition im August 1931 Von J P Jacobsen Pp 22 Serie Fiskeri, Bind 9, Nr 5 Periodic Fluctuations in the Size of Various Stocks of Fish and their Causes By Aage J C Jensen Pp 71 5 00 kr Serie Fiskeri, Bind 9, No 7 Marking Experiments with Cod at the Faroes, 2 Second Report Experiments in 1923-1927 By A C Strubberg Pp 36 3 00 kr (København C A Reitzels Forlag)

Memoirs of the Geological Survey of India Palæontologia Indica New Series, Vol 20, Memoir No 5 The Triassic, Jurassic and Cretaceous Gastropoda and Lamellibranchia of the Attock District By L R Cox Pp v+27+2 plates (Calcutta Geological Survey of India) 1 14 rupees , 3*s* 3*d*

CATALOGUES

The Wild Barfield Heat-Treatment Journal Vol 1, No 4, March Pp 41-54 (London Wild-Barfield Electric Furnaces, Ltd)

Botanical Books Herbals, Monographs, Floras, On Gardens and their Management, Wild Flowers, etc (Catalogue No 233) Pp 40 (London Dulau and Co , Ltd)

The "Wigmore" Epidiascope Pp 4. (London Newton and Co)

A Selection of Interesting Books on a Great Variety of Subjects (No 500) Pp 156 (London Bernard Quaritch, Ltd)

Micro-Projection Apparatus. (List MP 1935) Pp 12 (Manchester Flatters and Garnett, Ltd)

Heffer's Book Adviser No 8, March . Spring Announcements Pp 56 (Cambridge W Heffer and Sons, Ltd)

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Road Traffic Research

THE heavy toll of accidents on the roads in Great Britain, averaging at present about 20 fatal accidents and 590 non-fatal accidents a day, has at last thoroughly aroused public opinion, and the recent imposition of a speed limit of 30 miles an hour in built-up areas is the latest attempt to reduce the appalling toll of these accidents Important as the question of accidents may be, it is not the crux of the road traffic problem, and as Mr Mervyn O'Gorman pointed out in his lecture to the British Science Guild last December, which has recently been made available as a pamphlet*, an approach to the problem from this angle may lead to serious if not highly dangerous errors

The critical factor is the relation of road accidents to the magnitude and importance of road transport as a whole The figures supplied by Dr K G Fenelon in his paper to the Royal Statistical Society on February 19 show that in the sixteen years since the War, road transport has developed out of all recognition, and has had repercussions on the whole economic and social structure of Great Britain It is already one of our major industries, providing a livelihood for 690,000 persons In 1933, more than 2¼ million motor vehicles were in use , something like a quarter million workers were employed in the construction and repair of motor vehicles , exports produced by the motor industries amounted to about twelve million pounds sterling , 5,400 million passenger-journeys were undertaken on public service road vehicles which operated some 1,300 million vehicle miles About fifty-four million pounds sterling were expended on highways and bridges, and nearly sixty-nine million pounds gross were raised from motor taxation of all kinds

Motor transport is thus firmly established as an essential and co-ordinate part of our national transport system, and not as a mere subsidiary or auxiliary of the older forms of transport It is as much a public utility service as water supply or drainage, but as yet there has been no corresponding expenditure from the revenue raised from the industry on the scientific research essential for determining the adequate quantity of roads, their economic lay-out or the wise control and guarding of the traffic. Mr O'Gorman's plea for the scientific study of the traffic problem gives a picture of the services which science can render and of the dangers which attend legislation based on unscientific or haphazard experiment

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* Bringing Science into the Road Traffic Problem. By Lieut-Colonel Mervyn O'Gorman. Pp 36. (London British Science Guild 1935) 1s

The tragic position of the road traffic problem at the moment and the sterility of all attempts to diminish accidents, whether by motor control, registration, insuring, licensing or deterrent enactments, are due primarily to the omission to base legislation on scientific experiment and definite facts. In the absence of such study, well-intentioned legislation is apt to have consequences and repercussions widely different from or even opposed to those for which it was designed It is no longer rational to regard road transport as mainly competitive with the railways It is a complementary system providing a flexibility of paramount importance to certain classes of goods and industry, and any attack on the accident problem which impairs the efficiency of road transport as a whole might well be a national disaster

Despite the attention directed to road transport in the last few months, opinions as to the goal at which we are aiming or the improvements to be effected are often confused, and agreement as to what constitutes improvement has yet to be secured The subject is often discussed as if the mere reduction of accidents, irrespective of the volume of road traffic, were an end in itself, even if achieved by driving all traffic off the roads No more important point was made by Mr O'Gorman than his suggestion that our objective is to obtain an ever-diminishing fatality ratio, and only to achieve this under conditions or rules which will not block whatever expansion of safe road traffic the economy of the State may require from time to time

In the wide field for investigation which road traffic offers, certain subjects such as the examination of drivers, dazzle road illumination, skidding, noise, vibration, emission of dangerous fumes, are patently subjects for study by experiments conducted under disinterested scientific guidance, and investigations in this field are already being fostered by the Department of Scientific and Industrial Research at the Road Research Station and elsewhere In many problems, however, even the technique for acquiring data has yet to be evolved, and when the requisite data have been acquired there is the problem of securing uniform action on the part of the many authorities concerned, so that the advantages of a scientific policy may be secured for the whole country and not endangered by a recalcitrant or backward minority.

At the present time, the acquisition of data is the first necessity. The existing expenditure on road research, amounting to the very inadequate sum of £30,000, is devoted to road construction and materials; the cost of the research really required should be considered in relation not merely to the magnitude of road transport alone as a major industry, but also in regard to the estimates of the cost to industry as a whole of road transport accidents, loss in traffic delays, etc The cost of the committee and experimental work visualised by Mr O'Gorman would be infinitesimal in comparison with the outlay on research in the expenditure of any well-run factory if its income was scaled up to £71,000,000 For 1933, the loss to the community through the 191,782 road casualties is estimated at £30,000,000, and for London alone it is estimated that traffic delays cause a loss of £20,000,000 a year

It is in the light of such figures as these that the community must assess its capacity for expenditure on the fundamental research, and it should be noted that the solution of many of the more pressing problems is intimately related to questions of taxation, whether in the form of differential duties on heavier or lighter road vehicles or on land valuation and urban development Moreover, the unmixing of experiments which direction by a competent committee would ensure, and the planning of investigations to relate particular results with particular factors, would eliminate a good deal of the present waste of effort and money on experiments in which numerous factors are being varied simultaneously

To take only one example of these relations, a sound decision on the taxation of 12-ton lorries in favour of 3-ton vehicles depends on the effect on road safety of the increased traffic density induced thereby, the effect on the general fluidity of road transport, whether additional road construction is necessitated by the increased traffic density and the difference in road wear due to the 12-ton lorry in comparison with the 3-ton lorry. The answers to such questions are urgently demanded to-day, and they involve measurements of the effect of increments of traffic density on accident incidence and traffic flow, as well as that of total vehicle weight and speed on road maintenance. Cardinal to them is an instrument and a system for recording increments of traffic flow, and until we have set our hands to the evolution of scientific methods for measuring and recording traffic flow, traffic density and traffic accidents, our efforts at accident prevention are likely to revolve in a vicious circle with more and more serious effects on our national economy.

Almost the whole of our expenditure, national and local, on the control of cross-road traffic, on ribbon building along arterial roads, or on traffic regulation whether of lighting, orderliness or speed, including the punitive question, is liable to be fruitless for absence of the groundwork of definite facts on which to base wise decisions. It is possible of course for sound decisions to be taken fortuitously in the absence of such knowledge. It is equally possible for disastrous mistakes to be made, and no scientific worker can rest content with a situation in which wise or foolish action is determined by blind chance when the means for acquiring the fundamental information are to hand.

It is, of course, idle to pretend that the establishment of such a committee as that urged by Mr O'Gorman would immediately yield even a fraction of the data required. Probably twenty-five years would be required before the full data were available to justify or condemn the many so-called experiments at legislative control in operation to-day. None the less, systematic work under a scientific programme would assuredly yield results capable of practical application and increasing in value as accurate knowledge was built up of the laws of traffic flow. Mr O'Gorman's plea for accurate measurements in this mode of road traffic and for their scientific correlation and analysis is one which should have the insistent support of every scientific worker.

Reviews

The Problem of Chemical Linkage

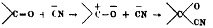
The Electronic Theory of Chemistry: an Introductory Account. By Prof. Robert Fergus Hunter. Pp. vii+125. (London: Edward Arnold and Co., 1934.) 8s. 6d. net.

IN contrast to a recent paper by Hunter and Samuel[1], which has been criticised even more adversely by physicists than by chemists[2], Prof. Hunter's book on "The Electronic Theory of Chemistry" is a trustworthy guide to modern views on the theory of valency, since it is very largely descriptive in character, and is more concerned with chemical facts than with physical theories. The chief fault that can be attributed to the book is a lack of historical perspective, which gives to it a flavour of immaturity. For this fault, geographical limitations may perhaps be held responsible. Thus it is unlikely that the *Zeitschrift fur anorganische Chemie* for 1893 is readily available in Aligarh, and it is difficult to discover evidence that the author had this volume before him when he wrote his account of Werner's theory of co-ordination, which is there expressed much more clearly than in his subsequent book. The author also omits to point out that the ideas of stable shells of electrons, and of chemical combination between atoms resulting either from electron transfer or from electron sharing, were introduced by J. J. Thomson[3] in 1907, and that their development in 1916 by Kossel and by G. N. Lewis respectively did not depend directly on the introduction of the nucleus atom in place of Thomson's model, but was an immediate sequel to Moseley's experimental determination of atomic numbers, which provided a firm arithmetical basis for the two conceptions which Thomson had already introduced.

Prof. Hunter is also apparently not aware that the term "intramolecular ionisation", which he uses at the beginning of chap. iii, was introduced by J. J. Thomson[4] in 1914 to describe dipolar molecules in which the centroids of the + and − charges do not coincide, and was afterwards applied by the reviewer[5] to those cases in which integral charges can be postulated on different atoms on the same molecule. There is no reference to the article in *Science*[6] in which Langmuir defined the *duplet* and contrasted *positive* and *negative valence* with *covalence* (the term covalency was *not* used by Langmuir). It is, therefore, perhaps not surprising that the author fails to attribute to Langmuir some of the fundamental ideas of the electronic theory of co-ordination, which were afterwards included in Sidgwick's theory; for example, the formation of a bond by the sharing of a duplet between platinum and ammonia, and the development in the compounds of the transition elements of large 'negative' valences, corresponding with Sidgwick's conception of 'effective atomic numbers'. No reference is given to the introduction of the terms 'ionotropy' and 'prototropy' in 1923, although a corresponding reference is given to the introduction of the terms 'anionotropy' and 'kationotropy' in 1931.

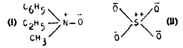
Whilst the main feature of the "electronic theory of chemistry" must always be the recognition of two main types of valency, as described in the second chapter of the book now under review, five central chapters are devoted to possible variants on these two types The ball was set rolling by the reviewer[7] in 1922, when he first suggested that a 'mixed double bond' could be formed by superposing an electrovalence on a covalence, as represented by the symbol $\overset{+-}{=}$ or $\overset{\rightarrow}{=}$, where the barb represents the direction of the field of force of the electrovalence Mixed triple and quadruple bonds were also postulated, but whilst the reviewer was responsible for *both* these symbols, Sugden alone was responsible for describing the preceding special case as a 'semi-polar double bond' Sidgwick afterwards used the symbol $\leftarrow$, with an arrow pointing in the opposite direction to the barb, to represent the formation of this type of linkage (which he described as a 'co-ordinate link'), by using the 'lone pair' of electrons of a 'donor', to make good the deficit of electrons of an 'acceptor', by sharing them between both atoms The reviewer's barb and Sidgwick's arrow are not inconvenient when applied to molecules, although an equation on p. 40 (in which two identical arrows mean quite different things) provides an excellent illustration of the more lethal character of Sidgwick's weapon, but in the formulation of ions, the scheme of localised + and − charges is the only one that is really convenient and quite free from ambiguity.

'Mixed' or 'semi-polar' double bonds were first postulated in 1922 in a paper on "The Polarity of Double Bonds"[7], as characteristic of the reactive forms of unsaturated organic compounds; and there is still no clearer method of formulating Lapworth's cyanhydrin reaction than by writing the equation ·



The curved arrows, now generally used to express such processes as these, provide a convenient subterfuge for those who are shy of introducing ionic reactions into organic chemistry; but they are less easy to interpret, as any novice may discover by attempting to read an equation at the top of p 103, which looks like a long-chain molecule with an assortment of lateral substituents.

Localised electric charges in the same molecule have long been familiar in the betaines, $\overset{+}{N}Me_3\,CO.\overset{-}{O}$, and in the *o*-, *m*- and *p*-sulphanilic acids, $\overset{+}{N}H_3.C_6H_4\,SO_2\,\overset{-}{O}$, as an alternative to the use of grotesquely elongated bonds, running like telephone wires from one atom to another; but opposite charges on contiguous atoms in stable systems were first suggested in a paper on "Intramolecular Ionisation", published in 1923[8]. Charges of this kind were then postulated (i) in molecules such as the amine oxides and (ii) in ions such as the sulphate ion, for example:



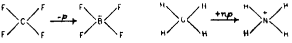
The most interesting of these oxides are those which illustrate Langmuir's theory of isosterism, since this theory enables us to pass easily and safely from the formulæ

$$N\equiv N \text{ and } O = C - O \text{ to } \overset{-}{C}\quad\overset{+}{O} \text{ and } \overset{-}{N} = \overset{+}{N} = O$$

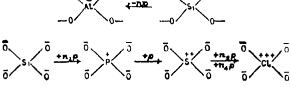
Since the electronic shells in isosteric molecules are identical, these formulæ can be derived from one another by a process of *nuclear substitution*,

$$^{12}_{6}C + {}^{16}_{8}O \rightleftharpoons 2\,{}^{14}_{7}N,$$

in which a neutron and a proton are transferred from one nucleus to the other, thus giving rise to the local + and − charges shown in the second pair of formulæ. In the same way, the borofluoride ion can be derived from the molecule of carbon tetrafluoride, by *removing* a proton from the carbon nucleus, whilst the ammonium ion can be derived from the molecule of methane by *adding* a proton and a neutron to the nucleus, which thus acquires a negative or positive charge respectively.



The same method can be applied to the giant molecule of silica and to the silicate ion, in order to justify the assignment of localised charges to the aluminium atoms of the aluminosilicates and to the central atoms of the phosphate, sulphate and perchlorate ions.



As Sidgwick has shown in the case of carbon monoxide[9], this nuclear substitution is not necessarily accompanied by the development of dipoles or quadripoles of equivalent magnitude, since the electronic system is flexible and can adjust itself, at least in part, to the new distribution of nuclear charges. The system of localised charges thus arrived at has been adopted on other grounds by Pauling and has been applied to crystal structures by W. L. Bragg and others, in a form in which, for example, a quarter of the field of the oxygen atoms of the phosphate ion is directed inwards to balance the charge on the nucleus, so that only a net field of $-\frac{3}{4}e$ is available to balance the external positive ions. The author's statement that "the theory of the co-ordinate link lacks the sound physical basis which has been provided for normal covalency by wave mechanics" is therefore only partially justified, and recent work by Penney has removed the last justification for this discrimination in the case of the mixed bonds of the sulphate ion, where the distribution of charges derived from wave mechanics has been shown to correspond closely with that postulated by the reviewer in 1922.

It is a curious anomaly that the new ideas and formulæ of the electronic theory of chemistry, which the author describes so clearly and convincingly in the present volume, have been the subject of recantation in a recent paper by Hunter and Samuel, where a reversion to pre-electronic formulæ is urged "on the basis of wave-mechanics and band spectra" Since, however, the suggested theoretical basis for these retrograde proposals is regarded as inexact by those well qualified to judge, students may be advised to buy and read the present volume without risk of being misled by doing so.

T M LOWRY.

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[1] *J Chem Soc*, 1180–1186, 1934
[2] NATURE, 134, 971, Dec 22, 1934
[3] "The Corpuscular Theory of Matter" (Constable, 1907), Chapter vi, pp 103–141
[4] *Phil Mag*, (vi), 27, 757, 1914
[5] *Trans Faraday Soc*, 18, 285, 1923
[6] *Science*, 59–67, July 22, 1914
[7] *J. Chem Soc*, 123, 822, 1923
[8] *Trans Faraday Soc*, 18, 285, 1923 *Phil Mag*, (vi), 45, 1105, 1923
[9] *Proc Roy Soc*, A, 144, 521, 1934

Physics Teaching in Germany and Italy

(1) *Lehrbuch der Physik in elementarer Darstellung* Von Arnold Berliner. Fünfte Auflage Pp vii+736. (Berlin. Julius Springer, 1934) 19 80 gold marks.

(2) *Fisica Generale e Sperimentale* Per Prof Eligio Perucca Vol 1 · *Meccanica, Calore* Pp xvi+647 85 lire. Vol. 2 *Ottica, Elettricità e Magnetismo* Pp xv+870 110 lire. (Torino: Unione Tipografico-Editrice Torinese, 1932–1934)

(1) THERE has too often been a tendency in the past among writers of elementary textbooks of physics to present the subject in a fragmentary form, to discuss isolated details with great care but to avoid a discussion of the broad principles, as if this would endanger the sanity of the student by bringing him into contact with philosophy. Prof Berliner deserves our thanks for defining at the very outset of his well-known textbook the mechanistic basis on which he afterwards builds, and he wisely devotes great attention and considerable space to the underlying principles of mechanics For him, a physical law is a formula which describes rather than prescribes the behaviour of physical objects He explains why we find it expedient to seek the 'forces' that give rise to observed phenomena and points out the fundamental part played by motions Although the efforts to obtain a mechanical interpretation of electromagnetic phenomena have failed, a study of mechanics is still as essential to the student physicist as is a study of Bach to the aspiring modern musician

Early in the book, the student is introduced to the ideas of world-point and world-line, but the way in which they were originally applied by Minkowski is left over to a later section, where there is an illuminating account of the idea of physical relativity, both special and general The claims (on p 133) concerning the confirmation of the general theory of relativity are stated with exemplary caution It is doubtful whether there is in existence another elementary book of physics in which the background of the subject, to use Sir James Jeans's apt expression, is so carefully kept in view For a parallel we should have to turn to the far more advanced books of Planck Goethe has wisely said "es gibt Bücher, durch welche man alles erfährt und doch zuletzt von der Sache nichts begreift" The student who works through the present book, however, should have no difficulty in grasping the fundamentals of his subject.

New features in this fifth edition include the geometrical structure of solid bodies and the properties of X-rays The final chapter is entirely new, and is intended to serve as an introduction to atomic physics The author mentions in his preface that since this subject does not properly belong to a textbook for beginners, he has not passed beyond the picturable Rutherford-Bohr model of the atom, as this may still be regarded as the threshold over which the student may later pass into the stately but rather forbidding mansion of quantum and wave mechanics. At the end of the text there is a record, covering fourteen pages, of the most famous names in physics, together with dates and discoveries

Compared with our English textbooks of the same standard, Prof Berliner's book contains remarkably few calculations, although even the Poinsot motions of a rigid body and Coriolis motions are discussed in a descriptive way The emphasis is laid throughout on the physical aspect For teaching purposes the book would gain by the addition of a set of carefully chosen illustrative examples and problems, the absence of which is rather common in foreign textbooks Prof. Berliner's book may be highly recommended.

(2) Prof Perucca's two volumes on general and experimental physics illustrate again the remarkable improvement that has occurred in recent years in the teaching of elementary physics The standard attained in the present case is about that of an English general degree These volumes represent the substance of a two years course of lectures to students at the Royal College of Engineering at Turin, but they should meet the requirements of pure science students equally well. Italian students are, indeed, fortunate in having so excellent an expositor as Prof Perucca, whose knowledge of every part of the subject is uniformly deep and accurate. The mathematical treatment is always simple, elegant and sufficient Engineers have a particular fondness for neat and clear diagrams. The author has been unusually indulgent in this respect, as the diagrams are in many cases excellent; for example, the *p-v-T* diagram on p 526 of vol 1, or the earlier figures relating to forced oscillations In the second volume special praise must be accorded to the chapter on capacity and dielectrics. The volume ends with short accounts of the photo-electric, photo-voltaic, Compton and Raman effects

The printing and production of the two volumes are of the highest order In view of the many English translations of foreign books on physics that have recently appeared, we may well ponder whether Prof Perucca's work has not an equal claim in this respect for a textbook of this standard.

H L B.

The Prehistory of Scotland

The Prehistory of Scotland By Prof. V. Gordon Childe. Pp. xv+285+16 plates. (London: Kegan Paul and Co, Ltd, 1935) 15*s*. net.

SINCE Prof Gordon Childe went to Edinburgh, he has made himself master of the ascertained facts regarding Scottish prehistory, and has brought a mind saturated with comparative data to a synthesis such as has not yet been forthcoming in book form In Scotland the main outlines were long ago drawn in by Dr. Joseph Anderson, but since his day a vast amount of information has accumulated, and a great deal has been learned in quite recent times Much remains yet to be done, so that while the body of fact is impressive, conclusions regarding origins and relations must necessarily be provisional. As the author himself writes in his preface, "The data are incomplete, and the conclusions it [the synthesis] offers are provisional or even premature". The conclusions set forth in this volume have authority as coming from one possessed of a wide and varied knowledge of European archæology, and the book will be of value not only to general readers, but also to workers in the field. If it increases general interest in Scottish archæology and stimulates research, it will do a notable service, and will be very welcome

The book opens with a useful and necessary chapter on the geographical and climatic conditions of prehistoric Scotland. It is quite impossible in a short notice such as this to deal in any detail with the vast amount of archæological data contained in the book The meagre evidence for a settlement or settlements of peoples in the epipalæolithic phase is presented, and Azilian, Tardenoisian and Baltic elements are recognised The local Neolithic and early Bronze (in which the author includes the English middle bronze) phase are already fairly fully known, and the current theories of a south-western (Iberian, to use the old term) origin for the people and culture of the chambered tombs, and a Central European origin for the short cist people with their beaker urns, are accepted, discussed and defined in view of recent discoveries Regarding the collective tombs, the author presents a case for the recognition of a type of corbelled tomb in Caithness, apparently belonging to an advanced phase of chamber building, as the earliest importation of the architectural idea from the Iberian peninsula, the segmented chambers of south-western Scotland, of simpler construction, being of later date and rather different origin The effect on the architectural features of the tombs of differences in the building materials available in different districts is pointed out, but perhaps not given quite sufficient weight. For some time now it has been supposed that the Beaker folk settled, not at a single but at a number of points on the east coast, and the author analyses the Beaker pottery from this point of view While he admits the origin of the food vessel from the older neolithic bowl, he suggests as a possibility a settlement of food vessel folk, as an alternative to the entirely local origin of this class of pottery. The evidence from graves makes this more than doubtful.

The bronze age in Scotland lasted for a long period, and the early Iron Age is represented, so far as funerary relics are concerned, by about six graves only. Certain of these indicate some connexion with the graves of the Arras group of chariot graves in Yorkshire, and one can be definitely dated to the first century A D. The culture was then definitely La Tène, and a colonisation from the south has been admitted about this time. The overlap from bronze to iron has been a dark epoch in Scottish archæology. The urn field and Hallstattian cultures of the Continent are only vaguely represented, and the evidences for local development, influenced of course by trade, are weighty. The author recognises Hallstattian influences in certain of the fictilia of the late bronze age and argues for a definite settlement of people practising the culture on the evidence of sherds of pottery with Hallstatt features in Aberdeenshire, Morayshire, Shetland and some other localities. Owing to the practice of cremation, no anatomical evidence for this is available, and the conclusion must be regarded as tentative The same must be said of the theory regarding the Broch builders—but this is too large a question to be included in this review All the author's conclusions will stimulate research and discussion, and are welcome on that account

The descriptions throughout the book are not too technical, and are happy in the way they seize on the essential points The maps of distribution, which have involved intensive work, are of much value

Short Notices

De Venarum Ostiolis 1603 of Hieronymus Fabricius of Aquapendente (1533?-1619) Facsimile edition with Introduction, Translation and Notes by Dr K. J Franklin. Pp viii+98+2 plates (Springfield, Ill, and Baltimore, Md. Charles C Thomas; London. Baillière, Tindall and Cox, 1933) 13*s* 6*d*

An important early work by Fabricius has now been published by the History of Science Society with the aid of funds contributed by the Carnegie Corporation All English readers who would fully understand the discovery of the circulation of the blood must, after studying the immortal "De motu Cordis", refer to the work of Harvey's precursor and teacher, Fabricius of Aquapendente, "De Venarum Ostiolis", and to that of his successor R Lower, "De Corde" By his scholarly translations of both of these works, Dr. Franklin has now completed the early trilogy of the circulation—complete in facsimile and translation and with all the original plates Discovery and publication were too often divided by long years The first unintelligent glimpses of valves by Canano 1541, Estienne 1545, Sylvius 1541 and Colombo seem to have been unknown to Fabricius in 1574 when he first made his discovery, and another twenty-nine years elapsed before he published it The salient points in his life are well indicated, and the construction of the anatomy theatre at Padua, where he lectured, is illustrated with architectural plans for the first time The eight fine full-page engravings of the original have been well reproduced, but we regret that the folding plate, pages 10 and 11, was not mounted clear of the stitching R T G

Müller-Pouillets Lehrbuch der Physik Elfte Auflage Herausgegeben von A. Eucken, O. Lummer, E Waetzmann. In 5 Bänden. Band 4. *Elektrizität und Magnetismus.* Teil 3: *Elektrische Eigenschaften und Wirkungen der Elementarteilchen der Materie* Herausgegeben von Arnold Eucken Pp. xviii+828. (Braunschweig: Friedr. Vieweg und Sohn A-G, 1933.) 54 gold marks.

The present volume of this well-known series of handbooks consists of the following parts: the free electron (cathode rays), by Gerthsen and Kossel; positive rays, passage of electrons through matter, by the same authors; discharges through gases, by Steenbeck; electrical structure of atomic nuclei, by Kirsch and Teller; atomic and molecular forces, by Dunkel and Wolf, dielectric polarisation of atoms and molecules, and pyro- and piezo-electricity, by Wolf The subject matter is treated simply throughout Many useful numerical data are found scattered over the various sections It is a particular merit of the volumes of this series that every effort is made to avoid rendering the reading irksome by inserting unnecessary formulæ or calculations The physical argument is clearly presented and references to original papers are given in abundance in footnotes

Earth, Radio and the Stars By Dr Harlan True Stetson. (Whittlesey House Publication) Pp xvii+336+9 plates (New York and London McGraw-Hill Book Co, Inc, 1934) 10*s* 6*d*. net.

There is always a peculiarly individual and peculiarly American quality about the work of Dr Harlan True Stetson, and the present work is difficult to sum up on that account The linkages amongst the rather diverse topics treated are somewhat slender and sometimes artificial, but as topics all are very interesting Variations in longitude and latitude, the internal structure of the earth, sunspots in relation to terrestrial magnetism and radio reception, problems of the ionosphere, solar, lunar and stellar effects on radio transmission, cosmic clouds, cosmic rays, are parts of a science, more attractive than the name 'cosmecology' which the author attaches to it, dealing with the relation of the earth to its cosmic environment The book is often stimulating, sometimes irritating, it contains much that is difficult to find elsewhere, and it should be read

Sound: a Physical Text-Book By Dr. E G Richardson Second edition Pp vii+319. (London. Edward Arnold and Co, 1935) 15*s* net.

When Dr. Richardson's book first appeared in 1927, it was described in a full review in these columns as "a well-balanced account of the present state of knowledge in experimental acoustics" (Nature, 120, 760; Nov. 26, 1927) Since then, much new work has been done on such subjects as sound-recording, echo-sounding, supersonics, architectural acoustics, limits of audibility, analysis of sounds, and so on, and the book has been expanded from 286 to 319 pages to take these and other advances into consideration. There are new chapters on impedance, supersonics, and the reproduction of sound.

Scientific Investigation of Works of Art

IN the field of the fine arts, it is axiomatic that the history of style cannot be separated from the history of technique and critical study of the latter depends upon two sources of information. Of these, documentary evidence is the more obvious and the less readily accessible. Some such manuscripts are of classical importance, and have been frequently edited and translated: probably the best known are the fifteenth century "Libro dell' Arte" of Cennino Cennini, and the much earlier "Schedula Diversarum Artium" of Theophilus Presbyter, of which first-class translations, critically edited and most copiously annotated, have recently been published. Numerous other early and medieval texts dealing with all phases of contemporary craftsmanship have been intensively studied, such as the Lucca "Compositiones" and the fourteenth century "De Arte Illuminandi", while many unpublished sources have yet to receive due attention. But comparatively few craftsmen have thus placed on written record their workshop methods ; and it can therefore scarcely be too strongly emphasised that detailed analytical study of actual surviving works of art constitutes a second potential source of information of the very highest importance.

Obviously, such sources are much more frequent than purely documentary evidence on the history of medieval craftsmanship; and the technique whereby a specific work of art was fashioned, be it painting, bronze, pottery or textile, may often be detected by the trained and discerning eye. It cannot be done in a day. Many tricks of medieval craftsmanship are still stubborn secrets; and though scientific methods of investigation, applied with reserve and artistic appreciation, have of recent years unravelled a good many such problems, yet the unwritten secret of, for example, the brothers Van Eyck, still continues to be 'discovered' at fairly regular intervals.

The names of a good many pioneer workers are intimately associated with this intensely interesting field where science and the fine arts overlap. It is perhaps invidious to particularise ; but Prof. Eibner and his collaborators at Munich, and Prof. A. P. Laurie in Great Britain, among many other workers, have contributed classical researches to the corpus of available knowledge. It should not be forgotten, further, that many museums, galleries, private research workers, and picture-restorers such as Dr. de Wild, have all made use of scientific methods for the examination of works of art. But all have admitted the disadvantages inherent in the general absence of a co-ordinating centre of research, though of recent years this deficiency has to some extent been remedied by the excellent work of one or two research departments. The laboratory of the Fogg Art Museum, at Harvard University, for example, has systematised many lines of research, and has provided by its quarterly publication, *Technical Studies in the Field of the Fine Arts*, a journal devoted exclusively to disseminating knowledge in this field. Further, the invaluable work carried out at the Research Laboratory of the British Museum has led to excellent publications on the constitution and care of museum pieces and works of art of various kinds. While paintings have, generally speaking, received little treatment at this latter centre, systematic investigation of such problems, particularly as applied to Russian icons and Byzantine wall-paintings, has been carried out in Moscow at the Institute of Archæological Technology and the Restoration Workshop. The results achieved there are not so widely known as they should be, however, largely owing to the language difficulty.

The recent establishment, by the University of London, of a Scientific Department at the Courtauld Institute of Art, has focused attention upon this field once more. The urgent need for the foundation of a centre where systematic investigation could be carried out into the physical character of works of art, and into the problems connected with their conservation and restoration, was made very clear at a Conference on Ailing Pictures convened by the Department of Scientific and Industrial Research on October 20, 1931. Full tribute was there paid to the work of the British Museum Research Laboratory, and of private investigators ; but it was felt that an independent and preferably academic centre would have great advantages over any existing institution, not only in carrying out research, but also in co-ordinating work already being conducted elsewhere. The new laboratory marks the fulfilment of the views expressed at this meeting; it is now fully equipped, and work is in progress. In addition to its research and educational activities, the laboratory is prepared to make scientific investigation into works of art of any type submitted by their owners, both public and private, reporting on their physical constitution and condition, and advising on questions of conservation and restoration.

Reports are, however, limited very strictly to matters of scientifically ascertainable fact : questions of attribution to a particular master are not taken up. The technique of a Holbein or a Rembrandt cannot yet be expressed as a mathematical function of the materials employed, nor can the *impasto* of a Rubens at present be differentiated from that of his pupils by any quality or quantity accurately measurable in absolute units

It is significant of the recent increased interest in such problems in Great Britain that the National Gallery has installed specialised equipment for the physical investigation and characterisation of its pictures; and this almost simultaneous establishment of two such research departments in London can scarcely fail to have an important bearing on this field of investigation

The results previously obtained have, perhaps inevitably, given rise to a certain amount of sensational publicity in the Press This is very regrettable; for not only has it led to popular misconceptions, and to the making of extravagant claims for certain scientific weapons, but also it has tended to suggest that all manner of questions, including the thorny problem of attribution, can be settled rapidly and with certainty by scientific means. The publicity accorded to the occasional detection of art forgeries by examination with X-rays, and with ultra-violet and infra-red radiation, has led many a layman to believe that such methods invariably reveal hidden features of deep significance In actual practice, nine out of every ten paintings, on X-ray examination, show nothing of significance—or, at least, nothing which can with certainty be interpreted at the present stage of our experience The outstanding difficulty in investigations of this kind is that of establishing a satisfactory control experiment—a norm for comparison It should never be forgotten that a work of art, of practically any kind, has to be regarded as a 'living' system, in a state of physico-chemical equilibrium which can be radically altered by factors at present almost unknown—as witness the sudden disintegration of certain Italian frescoes, without warning, after centuries of healthy 'life' The independent variables controlling such a system are so numerous that it is doubtful whether any given work of art will ever be defined by a set of specific and reproducible conditions Its very nature is so intensely individual that the cleverest forgery in existence would be an unsatisfactory control for experiment on the original To generalise on a few striking cases is, if possible, even less permissible here than in the exact sciences and significant progress will be obtained only after long-continued experiment under carefully controlled conditions P D R.

Origin of the British Flora

LIKE all other biological phenomena, the British flora is determined by two classes of factors, those of history and constitution on one hand, and those of environment on the other It is obvious that only those species which can at least tolerate the climate of these islands can continue to live here the discussion held at the Royal Society on March 28 was concerned mainly with the problem of how and when they came Light was thrown on this subject by contributions not only from taxonomists and students of the geographical distribution of species, but also from ecologists, meteorologists, geologists and archæologists, though it cannot be said that the problem taken as a whole is very close to solution despite the intensified field-work of recent years We are in fact no farther than the beginning of the laborious collection and analysis of detailed facts which alone can eventually lead to general agreement

Mrs. E. M Reid opened with a paper on "British Floras antecedent to the Great Ice Age" In dealing with the Tertiary floras, she showed that that of the London clay has a large preponderance of tropical, mostly Indo-Malayan forms, which she explained by supposing migration to north-western Europe along the shores of the Tethys Sea—that greatly extended 'Mediterranean' which persisted through so many geological ages. The evidence is that some existing British genera, absent from the London Clay, existed in these regions in earlier times (before the London Clay was laid down) and were presumably driven out by this invasion of tropical climate and flora from the south-east, but the floras of later deposits (subsequent to the London Clay) show a steadily increasing percentage of living British genera, culminating in the late Pliocene with 97 per cent It is generally accepted that the climate and flora of the Cromer Forest bed at the top of the Pliocene were roughly equivalent to those of to-day, and may therefore be taken as the real starting point of the modern flora

Then came the cold of the Pleistocene with the advance of the great continental ice-sheet from Scandinavia and the formation of glacial systems in the mountains of Great Britain It is obvious that these conditions must have exterminated or driven southward most of the existing flora, since the ice advanced at one time to the northern edge of the Thames Valley, and later to South Wales. It is now established, however, that there were four successive glaciations in England—though these do not necessarily correspond at all closely with those of the Continent—and correspondingly three interglacial phases. Prof P G H Boswell, whose work has greatly increased our knowledge of the Pleistocene period in Britain, sketched the history of these successive glaciations The second reached farthest south in the east (Thames valley), the third and fourth in the west (Bristol Channel) The floras of the interglacial phases when the ice retreated were touched upon by Miss M E J Chandler During the second (middle) interglacial phase, much of our existing flora was present in eastern England, which was at that time joined to the Continent owing to general elevation of the land. Of the others little is known, and there is no evidence that any interglacial was much warmer than the present climate 'Nunataks' (ice-free areas surrounded by ice) no doubt existed during the glaciations, but according to Prof Boswell it is uncertain whether any of these were continuous throughout the Pleistocene, and could thus possibly afford a permanent refuge for Pliocene plants According to Dr Raistrick, there were 50 square miles of such ice-free areas in the Pennines, though none in the Lake District mountains But there is still some difference of opinion on this point The most generally accepted view is that at any rate the great bulk of the existing flora came into Great Britain from the Continent after the final retreat of the ice

The main issue of controversy on the effect of the ice age on the British flora lies in the question whether practically the whole vegetation north of the Thames and Bristol Channel was wiped out, except such as could survive in the comparatively narrow strip south of the ice-sheets, or whether a substantial portion at least survived in ice-free 'sanctuaries', and in the south-west from interglacial or even from Pliocene times In the discussion, Dr A J Wilmott was the protagonist of the latter, Prof E. J. Salisbury of the former view Dr Wilmott's evidence is (1) the occurrence of certain endemic species which are regarded as relics of Pliocene or a warm interglacial period and are very unlikely to have originated in post-glacial times, (2) the aggregations of rare and local species in unglaciated areas south of the ice-sheet such as Brean Down in Somerset and Torquay, or in unglaciated areas surrounded by ice such as Teesdale and Arran. It seemed to him "inconceivable" that such species would have migrated separately to these areas in post-glacial times, avoiding intervening and equally suitable habitats They must rather be regarded as relicts which have survived in these places Prof Salisbury, on the other hand, argued that these collections of rare species have occupied such areas in post-glacial times because the local conditions are particularly suitable for them He does not believe that the cumulative effect of very cold conditions during a glacial phase would permit the survival of such species within the boundaries of or in proximity to an ice-sheet, or that any bounds can be set to the post-glacial migration of species within the British Isles, provided the conditions of existence are suitable for their establishment

The view that relict species surviving the last glaciation may probably be fairly numerous in the British flora was supported by Prof G E. Du Rietz, of Uppsala, who gave many examples of species concentrated and isolated in two mountain areas, one in the north and the other in the south of the Scandinavian peninsula; these can only be interpreted as relict areas, since the nature of the habitat does not in any way explain this localisation of species He also described Norwegian coastal areas which were free of ice during the Pleistocene and possess remarkable collocations of species, and particularly one in Novaya Zemlya in proximity to the existing ice-sheet and known as "flower hill" These instances taken together greatly strengthen the case for survival close to the ice Furthermore, he instanced a species of tropical rain forest lichen still found in south-west Ireland, the presence of which he is only able to interpret as a survival from a pre-glacial tropical climate Prof Du Rietz confessed himself "rather an extreme advocate" of the theory of survival of pre-glacial relicts, believing that a great part of the oceanic (Atlantic) flora survived in the south-west of the British Isles, though he did not oppose Prof Salisbury's contention that the distribution of very many species followed the differentiation of climate, and was thus determined by existing environment rather than by the more remote history of the species Dr W Watson cited several examples of Scottish liverworts and lichens occurring in isolated positions in southern England, both in the west and in Norfolk, interpreting these as glacial relicts

There certainly seems a good deal of evidence derived from the existing distribution of particular species, not only in the British Isles but also on the Continent and in America, for the survival of relicts in particular places, doubtless in more or less specially suitable habitats, from various earlier periods, surrounded by a flora of which they do not form an integral part. But we are still very far from being able to write a convincing history of the extremely complex changes which must have occurred since the Pliocene. Our ignorance of the climates which actually existed in proximity to the ice-sheets is almost complete We cannot assume that all the unglaciated parts of the British Isles must have been arctic tundra The evidence from southern Sweden and Esthonia is that the forest zone there came very close to the ice, and, for all we know, quite mild conditions may have existed in our own south-west, enabling the survival of many 'Atlantic' species, among which may be reckoned the so-called 'Lusitanian' flora, species which occur in south-western Ireland or in south-west England and also in the Iberian peninsula—some being present in and some absent from western France—among which the strawberry tree (*Arbutus unedo*) is perhaps the best known

Several speakers—for example Miss Chandler, Prof Boswell, Dr W B Wright, Mr Butcher and Dr Hamshaw Thomas—emphasised from different points of view the extreme complexity of the changes and the wide fluctuations of climate and other conditions which must have occurred during the Pleistocene Other speakers, again, directed attention to factors which are probably of great importance but are often ignored—Dr. Thomas to the importance of precipitation and accompanying humidity of the air, in addition to temperature, Dr A S Watt to soil development, different soil phases limiting the spread of particular species and favouring that of others; Dr W. B Turrill to 'ecotypes' within an aggregate species which may all have a general superficial resemblance but in reality differ greatly, both in genetic constitution and in ecological requirements

Dr H Godwin gave a lucid account of the application of the modern technique of pollen analysis to the interpretation of the post-glacial history of the British flora, showing that the succession of forest types in Britain agrees very well in a general way with that recorded from the Continent It is difficult to judge the time of the first appearance of the dominant trees, but the order in which they spread and attained dominance can be determined with some certainty The earliest post-glacial forest phase (Boreal) shows dominance of birch and pine and the entry of elm, oak and lime Later came the alder, and the next climatic period (Atlantic) saw mixed oak-forest and alder dominant It is now certain also that beech, on the native place of which doubts have been cast, was present in pre-Roman (probably Iron Age) times, and hornbeam has a similar status. Both these records agree well with the late post-glacial spread of the two trees on the Continent There is also evidence of a second pine forest maximum between the early Bronze Age and the Roman period, and this perhaps corresponds with the Sub-boreal pine maxima in Ireland, Scandinavia and other parts of Great Britain Not very much is certainly known of the pollen of British interglacial beds, but the presence of spruce—now extinct—has been established, so that extermination of some species at least during the later glaciations appears to be demonstrated

A G TANSLEY

The Alkali Industry

IN the Hurter Memorial Lecture to the Society of Chemical Industry (*Chemistry and Industry*, 54, 121; 1935), Dr J. T. Conroy gave a very interesting review of the development of the manufacture of sulphuric acid, alkali, chlorine and allied products since about 1890. This period has seen the disappearance of the Leblanc process and its replacement by electrolytic processes, the Castner and Hargreaves processes developed in Great Britain having features embodied in most successful modern cells except those of the gravity type. The possibility of operating these processes was almost entirely dependent on power production. The original rocking mercury cell has given way to a trough type with many times the capacity of the original unit, and the use of Acheson artificial graphite for the anodes was a material improvement. The high degree of purity of the caustic soda produced by the Castner cell, fitting it for the electrolytic production of metallic sodium, was very helpful to its development. The sodium is the starting material for the manufacture of cyanide. For the last fifteen years the chlorine produced in Great Britain has been electrolytic in origin.

In the ammonia-soda process, improvement in plant and operation has been effected, and processes for the production of sal ammoniac and calcium chloride from appropriate tower and still liquors have been developed

Although the Leblanc cycle has been superseded, some intermediate products are still important Sulphuric acid is made by the chamber process, in the operation of which some mechanical improvements have been effected, and on the chemical side the use of nitre has been replaced by ammonia oxidation Concentration of acid in platinum pans has given way to other types of apparatus and finally to the contact process It is only with large installations and a demand for high strength acid, such as is necessary in the dyestuffs industry, that the contact process is economical. The use of sulphur has replaced that of pyrites to a large extent since the exploitation of the American deposits by the Frasch process.

The manufacture of saltcake (sodium sulphate) has declined considerably, partly because saltcake is now largely displaced by ammonia soda ash in glass manufacture and partly because the export market demands have been largely met by the recovery of sodium sulphate from residual liquors from the recovery of natural potash at Kaiseroda and Borbach, from which on refrigeration Glauber's salt is obtained, yielding saltcake of high purity on suitable heat treatment.

The Weldon chlorine process had been displaced by the Deacon process as improved by Hasenclever. The production of 1 ton of bleaching powder by the Weldon process required 50 cwt of salt; in the Deacon process appreciably less than 20 cwt. was used. Kynaston found that the undecomposed hydrochloric acid washed from the chlorine was almost free from arsenic and contained but little SO_3, so that this acid could be sold and the costly Hasenclever process, degassing the condensed acid for return to the decomposer, could be avoided. A revolution in the manufacture of hydrochloric acid came with the production of synthetic acid from the hydrogen and chlorine gases from the electrolytic cell, and a high proportion of the acid is now produced synthetically.

In the manufacture of bleaching powder, the use of the Hasenclever plant, in which mechanically hydrated lime is pushed through horizontal superimposed cylinders in counter current to the ascending chlorine, has been modified by the omission of the propelling blades and the use of a single enlarged rotating cylinder for the smaller units (Moore and Rudge). The chlorine from the electrolytic cells is diluted with air before use, and by suitable regulation of the process and control of temperature in particular zones of the cylinder by water cooling, a high strength bleaching powder possessed of stability in hot climates can be produced. Calcium hypochlorite containing more than 70 per cent available chlorine, and sodium hypochlorite solutions containing up to 15 per cent available chlorine are produced for water purification, sanitation, laundry work and other purposes.

The production and sale of liquid chlorine for water purification and the preparation of intermediates in the dyestuffs industry is another notable achievement. Chlorate production is now also electrolytic and is carried out in countries such as Sweden and Canada where cheap water-power is available.

In the caustic soda industry, the carbonate from the ammonia soda process is causticised with lime, the calcium carbonate in granular form being removed by rotary filters and used as agricultural lime, in 'stone dusting' in coal mines and, when carefully dried and air-separated, in other industries. Regeneration of lime from the lime mud has more recently been accomplished. The caustic soda liquor is concentrated in multiple effect evaporators and further in steam-heated units, the product being of high strength, 70 per cent Na_2O being normally attained, whilst with the mercury electrolytic cell a product approximating to 100 per cent NaOH is obtainable. New forms of caustic soda known as flake, petal and powder, are made by breaking down thin sheet, they are easy to handle and much purer than the old stick form.

Purity of the modern products is due partly to the basic change of process, for example, contact process for sulphuric acid and synthesis of hydrochloric acid, and partly by the possibility of installing purification plant owing to economy resulting from greater output per unit of plant. Fuel economy has been largely effected by the development of the tubular boiler and the steam turbine. The use of control instruments and better working conditions on the plant, as well as the introduction of metals and alloys capable of resisting corrosive liquids and gases, have all played a part in the improvement of the industry. Dr. Conroy emphasised that the continuous high efficiency now ruling can only be maintained and ensured by continuous scientific control.

Obituary

PROF. E. PATERNO

THE death of Emanuele Paternò removes a leading Italian chemist and a genial collaborator from the international councils of chemistry, where he regularly represented his country. Prof. Paternò passed away on January 18 in his native city of Palermo, where he was born on December 12, 1847. His father had to leave Sicily soon after his birth, having taken an active part in the revolt of 1848, and Emanuele spent his early years in exile, in Alexandria.

Having graduated in physics and chemistry, Paternò returned to Palermo, replacing in 1872 the famous chemist Cannizzaro, who had just left for Rome. In 1893 he was called to the chair of applied chemistry in Rome, and on the death of Cannizzaro he became director of the Chemical Institute.

Paternò's scientific contributions over nearly half a century are numerous and varied. He began his scientific career with the discovery of dichloraldehyde, and made a special study of the halogen isomers of ethane, the synthesis of fluorbenzene, fluortoluene, etc. Passing on to physical methods, he made numerous cryoscopic studies in connexion with the determination of molecular weights, and later in life investigated colloidal phenomena and the influence of light upon chemical reactions.

Paternò was the first to point out, in 1889, the emulsion-like nature of colloidal solutions, and to note that a substance may be colloidally dispersed in one solvent and molecularly dispersed in another. In the photo-chemical field he obtained by elegant methods condensations of hydrocarbons with aldehydes and ketones, he succeeded in preparing a number of synthetic alkaloids and was able to throw light on the probable mechanism by which plants produce many of these compounds.

In addition to his research activities, Paternò excelled as an organiser. He founded and edited the *Gazetta Chimica Italiana*. In Palermo he was both principal of the University and mayor of the City, and in Rome he occupied many Government positions. A gold medal was founded in 1923 in his honour, to be given every three years for the most notable discovery in chemistry, the first award being made in the same year to Dr. F. W. Aston. Prof. Paternò was elected an honorary fellow of the Chemical Society in 1920.

SIR WILLIAM MORRIS, K.C.M.G., C.B.

WE regret to record the death of Sir William G. Morris on February 26, in North Wales. He was a man beloved by all who had the privilege of knowing him. Born in 1847, he entered the Corps of Royal Engineers in 1867. After various home duties he went to Mauritius in 1871 and remained there until 1874, the year of the transit of Venus expedition to that island, with which the names of Lord Lindsay and Sir David Gill are so intimately associated. This appears to have marked the beginning of that collaboration with Gill which was later to have such useful results in South Africa; for after a spell of two years at the Staff College and later at home duties—particularly as assistant instructor in survey at the School of Military Engineering, Chatham, from 1877 until 1882—he was acting on special duty in 1882–83 under the Transit of Venus Committee at home and abroad.

At this juncture, Sir David Gill, who was then H.M. Astronomer at the Cape of Good Hope, had succeeded in persuading the Governments of Cape Colony and Natal to undertake a geodetic survey of their territories. To carry out this work Gill naturally turned to Morris, who after two months work on special duty under the Colonial Office, became the leader of the Geodetic Survey of the two Colonies, an undertaking which absorbed his energies for ten years. Officially he was noted for special duty under the Government of Natal, which was the first of the two Colonies to support Gill's proposal for the geodetic survey. This work, indissolubly associated with the names of Gill and Morris, was the beginning of the Great Arc of the 30th Meridian which last year was carried to the Belgian frontier of the two provinces of Ruanda and Urundi.

On his return home, Morris received the C.M.G. for his services on the geodetic survey of the Cape and Natal. He next went to Chatham and in the period 1895–98 was assistant commandant of the School of Military Engineering, but South Africa was calling, and he returned there in 1898 as Colonel on the Staff, C.R.E., acting as district engineer during the South African War (1899–1902). He was twice mentioned in dispatches and received various honours and the C.B. After the war an occupation doubtless more congenial to his nature was in store for him: in 1902 he became officially superintendent of the Geodetic Survey of the new territories, and in 1906 completed the principal triangulation of the Orange River Colony (as it then was) and the Transvaal. He retired from the Army on half pay in 1904 and for the last thirty of his long spell of eighty-eight years lived very quietly on a mountain side overlooking Bettws-y-Coed. Visiting him there about three years ago, the present writer found that his mind had apparently drifted beyond South Africa, the scene of his former triumphs.

Gill and Morris built up in South Africa a fine school of geodesy. Supported by able assistants, they established a tradition which has not been without effect on the world at large. Mr. Victor A. Lowinger, one of these assistants, writes: "Morris was devoted to his work and inspired all who worked under him with the value of thoroughness and accuracy. He chose his men carefully and trusted them to get on with the job, while at the same time he was always ready to resolve any difficulties that arose. He was of a very reserved nature and, though a little intolerant of human weaknesses, very just in his judgments—a man with whom one has been proud to have been associated in one of his great practical contributions to geodesy." G. T. M.

MR. M. V. PORTMAN

WE regret to record the death of Mr. Maurice Vidal Portman, which occurred at Axbridge, Somerset, on February 14, at the age of seventy-four years. Mr. Portman was well known as an authority on the natives of the Andaman Islands as they existed fifty years ago. He was appointed "Officer in charge of the Andamanese", with headquarters at Port Blair, in 1879, and remained in the Andamans until 1899, when he was sent home on account of ill-health. Throughout his term of duty he was in constant and intimate touch with the life of these tribes of shy, difficult and sometimes dangerous, little people. As a result of his care for them and his disregard for the risks he ran in getting into touch with them, he acquired knowledge of their customs and beliefs which made him the equal, if not indeed the superior, as an authority, of E. H. Man, although the latter won the wider reputation through his books. Mr. Portman was a contributor of papers on Andamanese matters to the publications of learned and scientific societies, and made a remarkable collection of photographs of the Andamanese and their articles of material culture.

WE regret to announce the following deaths:

Sir John Rose Bradford, K.C.M.G., C.B., C.B.E., F.R.S., emeritus professor of medicine in University College, London, president of the Royal College of Physicians in 1926–31, on April 7, aged seventy-one years.

Prof. E. Cannan, emeritus professor of political economy in the University of London, on April 8, aged seventy-four years.

News and Views

Planning in Industry

PLANNING in industry was debated in the House of Commons on April 3, following a motion by Mr A H. E Molson calling for the establishment of a Departmental Committee to consider the measures of industrial reorganisation necessary for the fullest use of modern methods of production and distribution in Great Britain Mr Molson urged the necessity for dealing with the industrial position of the country as a whole and not by Departments of State or the like singly, and referred particularly to the reduction of costs of production and the question of cheap distribution Organisation of industry on a national basis was regarded by Mr C U Peat as essential, both for the older and the newer industries, thus organised self-government would have avoided the present desperate redundancy problem in the canning industry. The essence of the proposal was that the majority of an industry should have the opportunity of putting their case before an independent tribunal, and on satisfying the tribunal that re-organisation was in the interests of producers, consumers, wage-earners and other allied industries, statutory authority should be given to the reorganisation scheme without delay, so that the industry should be organised on the most efficient basis it could suggest Mr H Macmillan said further that the question was not one of Government interference with industry but the giving by Government of certain rights to industry by permissive legislation to undertake its own reorganisation Under certain safeguards, majorities should have the right to govern

DURING the debate, Mr G Le M Mander advocated the establishment of a committee of national development to formulate a consistent and comprehensive policy for the development of our national resources and to co-ordinate the work of different Departments of State Sir Herbert Samuel, referring to the dangers of bureaucracy, emphasised the importance of management The ablest leaders of industry, he said, are themselves in favour of larger measures of reorganisation for the industries in which they are engaged The opposite point of view was voiced by Mr. R. Assheton in a brilliant plea for independence and the adventurous spirit in industry on which progress primarily depends, and which is liable to be stifled by rigid organisation. The dangers of eliminating small enterprises were real and Mr. Assheton feared the effect of planning on business confidence. Mr. W. Runciman, for the Government, emphasised the success of voluntary schemes of industrial reorganisation and referred to some of the failures in rationalisation. He expressed the opinion that the reorganisation of all the great industries of Great Britain cannot be achieved by one and the same effort. The motion was by leave withdrawn

Development of Colonial Forest Resources

THE Secretary of State for the Colonies has set up an organisation under the Colonial Office for the development of colonial forest resources By consent of the Department of Scientific and Industrial Research, two of its technical officers have been transferred to the new organisation, namely, Major F M Oliphant, lately assistant director of the Forest Products Research Laboratory, Princes Risborough, and Major J R Cosgrove, lately in charge of the Section of Utilisation at the Laboratory. Major Oliphant, as forest economist, will deal mainly with the organisation of production, and will spend much of his time in the Dependencies concerned, while Major Cosgrove, as market development officer, will be engaged in market promotion work, with reference to the United Kingdom market and other markets, both British and foreign The organisation will be chiefly concerned with timber development, but will also interest itself in other forest products, such as wood pulp, fibres, gums and resins and the like In both directions it will co-operate with the Imperial Institute It will also work, of course, in close co-operation with the Forest Products Research Laboratory The Laboratory, as a research institution, will henceforward confine itself to questions involving scientific investigation and tests, while the new organisation will take over the market promotion work, including commercial service trials, which the Laboratory formerly carried out under temporary arrangements on behalf of the Empire Marketing Board The organisation will for the present be quartered at the Imperial Institute Inquiries should be addressed to the Colonial Forest Resources Development Department, Imperial Institute, London, S W 7

Statistics of Industry in England and Wales

STATISTICS of industry derived from the 1931 census of England and Wales have recently been published (London : H M Stationery Office, 32*s*. 6*d*), and as the analysis is on a more comprehensive scale than any hitherto published, the volume is of exceptional interest A valuable feature is the rough comparison with previous censuses, examples of which are given in the following table

Industry	1911	1921	1931
	Persons (in thousands)		
Coal Mining	971	1,133	1,030
Iron and Steel	166	239	198
Building, Decorating	861	758	1,048
Agriculture	1,230	1,124	1,018
Cotton	628	596	571
Electrical Apparatus, etc	80	166	268
Chemicals, Paints, Oils	133	198	211
Hosiery	59	80	110

In certain industries, for example, coal mining, iron and steel, engineering and shipbuilding, exceptional expansion took place during the War, but this was followed by a considerable readjustment during the last decennium. In others, for example, building, personal service, boots and shoes, there was a marked decline, but recovery followed after the War. The numbers engaged in agriculture, cotton and lace have declined in each census since 1911, though in poultry farming there has been an increase from 12,200 persons in 1921 to 27,700 in 1931 The manufacture of electrical apparatus, chemicals, paints and oils ; hosiery , food , printing and bookbinding , road transport , and a number of other industries have expanded considerably in both census periods since 1911 An interesting fact recorded in the latest census is a great increase in the number of male commercial travellers, from 81,347 in 1921 to 120,212 in 1931

Economic Study of Japan's Population Problems

"CONFLICT and Co operation, Economic and Political, in the Pacific" formed the theme of the Cawthron Lecture, 1934, delivered by Mr. Frank Milner, at Nelson, New Zealand (Nelson, N Z · Cawthron Institute, 1934) There are, he said, ominous explosive potentialities in Japan's growing population pressure with its increase of more than one million per annum Her population density is now 437 persons to the square mile, and though this is exceeded by Java, Belgium, England and Holland, the situation is complicated by the fact that only 16 per cent of the land is arable With 2,774 persons living on each square mile of such land—not a foot of land being wasted—Japan has reached the point of complete saturation Half the farms are less than 1¼ acres in extent and three-quarters less than 2½ acres. The Japanese are not an emigrating people, and there are only about 635,000 living abroad The only feasible solution of the basic population problem of Japan is the development of manufacture and trade, though inadequate resources of coal, iron ore, petroleum and other raw materials handicap her industrial expansion. Moreover, Manchuria, according to scientific experts, cannot provide coal or iron ore of the type needed for Japanese blast-furnaces The shift from an agricultural to an industrial economy is far from complete, and at present less than 10 per cent of the population work in factories employing more than five persons Japan to-day is the real problem of the Pacific, and her isolation is breeding an ugly mood in her militarists The solution may involve regional allocation of raw materials and markets to Japan involving heavy sacrifices, but such co-operative effort must be made if a cataclysm is to be avoided

François Emmanuel Fodéré

THE centenary of the death of François Emmanuel Fodéré, who was born on January 8, 1764, is to be celebrated on April 12 at Strasbourg, where he was professor of medical jurisprudence from 1814 until 1834. His "Traité de médecine légale et d'hygiène publique ou de police sanitaire", of which the first edition was published in 1798 and the second in 1813, was the standard work in medical jurisprudence in France during the early part of the last century. In 1819 he was appointed lecturer in the history of epidemic diseases and hygiene at Strasbourg, his lectures being afterwards published in four volumes in 1822–24. His other works included "Traité du goître et du crétinisme, précédé d'un discours sur l'influence de l'air humide sur l'entendement humain" (1790), "Essai historique et moral sur la pauvreté des nations, la population, la mendicité, les hôpitaux et les enfants trouvés" (1825), "Recherches sur la nature, les causes et le traitement du Choléra-morbus" (1831) and 'Essai sur les diverses espèces de folie" (1832)

Moses Maimonides

THE January issue of *Medical Life* is a Maimonides number containing an account by Prof Louis Gershenfeld, of the Philadelphia College of Pharmacy and Science, of the Hispano-Jewish physician, astronomer and theologian, Moses Maimonides or Abu Amran Musa Ben Maimon, on the occasion of the octocentenary of his birth Born at Cordova in Spain on March 30, 1135, he studied under Averrhoes, and in 1160 left Spain for Fez, finally settling in 1165 at Cairo, where he died on December 13, 1204. His best-known medical work is a collection of 1,500 aphorisms from Galen's writings with forty-two critical comments His other chief medical works are a treatise on diet and personal hygiene written at the request of Saladin's eldest son, who suffered from melancholia, and a book on poisons and antidotes In a work on astronomy, he recognised the limitations of astrology, and declared that all works on the subject were the products of fools He differentiated between astrology and astronomy, maintaining that in the latter only was to be found true and necessary knowledge His most famous work, however, was the "Guide for the Perplexed", which was not intended for popular consumption, but claimed to be written by a philosopher to the philosophically minded, his purpose being to reconcile Aristotelian philosophy with Jewish theology and the doctrines of Judaism

Water with Heavy Oxygen

THERE has recently been erected in the Chemistry Department of the University of Manchester an apparatus of the type first described by Hertz (*Z Phys* , 79, 108 , 1932) and afterwards modified by Harmsen (*Z Phys* , 82, 589 , 1933) for the separation of gaseous isotopes by diffusion The immediate object is to prepare oxygen containing an excess over the normal of the O^{18} isotope For this purpose it is convenient to diffuse water vapour rather than oxygen itself The abundance of H_2O^{18} is approximately 1 . 500 and the ratio of the vapour densities of the 'heavy' and 'normal' water is 10 · 9 The apparatus was designed to yield water containing about one per cent of H_2O^{18} The process of separation is very much slower with water vapour than with permanent gases owing to the adsorption of the vapour on the walls of the porous tubes used for the diffusion This adsorption is large even at 100° C A trial run just completed has yielded about 20 mgm of water the density of which is greater than normal by about 25 parts per million, which is scarcely if at all outside the experimental error of the density measurement. The apparatus is now being modified somewhat to allow of faster working, and it is hoped that it will yield about 20 mgm a day of water containing 0·5 to 1 per cent of H_2O^{18}. The water so obtained (or the oxygen prepared from it) will be used as an 'isotopic indicator' in reactions involving oxygen. A specimen of such water prepared by Hertz has already been used to investigate the mechanism of saponification of esters (Polanyi and Szabo. *Trans. Faraday Soc.*, 30, 508; 1934).

The Naturalist in the Laboratory

SIR FREDERICK GOWLAND HOPKINS delivered the Bacot Memorial Lecture entitled "The Naturalist in the Laboratory" before the London Natural History Society on April 2. Sir Frederick pointed out that early biology was limited to study of the physiology and morphology of plants and animals (chiefly vertebrates), the causes which affected them being largely conjectural; the chemist provided means of elucidating these problems. Observation of the bombardier beetle and its explosive excretion first attracted Sir Frederick's notice to these matters fifty seven years ago, and despite this first experiment proving fruitless, it was this which led to his taking up biochemistry. The work of the biochemist in comparing the action of catalysis with enzymes has established the processes at work which enable both plant and animal to digest and transform food materials into substances suitable for oxidation to enable life to continue. But it does not stop there, for it has shown the relationship between species by the parallel processes carried on in similar species, and that each species may have its own process. A further stage has been to show the necessity for certain substances to allow the full utilisation of food supplies. Known as vitamins, they provide the means for the body to obtain enough fuel to supply full growth and reduce vulnerability to disease. Although systematic, taxonomic, morphological and physiological research must continue, and the biochemist can still open new avenues for exploration, there is every scope for wide co-operation between all branches of natural history from an ecological point of view. Finally, although exact chemical reactions in plant and animal can be ascertained and reproduced experimentally, and although living tissues can be made to function under artificial conditions, the origin and nature of life is a matter which scientific research has yet to explain.

A New Wind Tunnel

THE new 24-ft. wind tunnel at the Royal Aircraft Establishment, Farnborough, opened by the Secretary of State for Air on April 5, is the largest in Great Britain. It can contain a complete aeroplane, all of the machine except the outer portions of the wings being in the air stream and under observation. Air speeds equivalent to 115 miles per hour are obtained. The principal immediate use of this type of tunnel is the investigation of 'interference' between various bodies in juxtaposition, such as airscrews and engine cowlings, which cannot be studied precisely upon small-scale models. Such problems cannot be examined as fully as is necessary in actual flight owing to the uncertainty of the steadiness of the air at the moment of taking an observation, and moreover, such experimental flying with new and untried design ideas involves considerable risk, and often delay, in bad weather. This tunnel is not the largest in the world, there being a 60 ft. × 30 ft. one at Langley Field, United States, and a 50 ft. span one in France (see NATURE, Feb. 16, 1935, p. 252). It is interesting to note that one of the first machines to be investigated in this channel will be a new one that has exceeded its anticipated performance in certain respects by so much as to shake confidence in the accepted methods of estimating the total air resistance of combinations of differently shaped bodies.

Shortt Clock at the Science Museum

A SHORTT free pendulum clock has recently been installed at the Science Museum, South Kensington, and is now at work controlling the main public dials of the Museum. The Shortt clock was perfected by Mr. W. H. Shortt in 1921 as a result of a long period of experimental work in association with Mr. F. Hope-Jones and the Synchronome Company; the first clock was set up at the Edinburgh Royal Observatory in 1921, and Prof. R. A. Sampson's report on its first year's run aroused great interest among astronomers, as it had proved to have surpassed all previous clocks in its accuracy. A Shortt clock was adopted as the sidereal standard at Greenwich at the beginning of 1925, and has proved itself capable of measuring time to an accuracy of a few thousandths of a second per day, or better than 1 in 10^7. The clock now exhibited in the Science Museum is identical with these observatory clocks except that the usual exhausted copper case for the free pendulum is replaced by a dust tight glass cylinder; the clock is mounted on the wall of a public gallery with its slave clock by its side. The delicate method of imparting an impulse to the free pendulum and the action of the hit-and-miss synchroniser can thus be studied in detail.

Excavations at Jericho, 1934–35

DURING the season which has just closed, Sir Charles Marston's archæological expedition to Jericho, of which Prof. John Garstang is field director, has penetrated to the neolithic levels of earliest occupation which, it is found, cover a considerable portion of the site, under deposits of the Early Bronze Age measuring 27 ft. thick. In the neolithic levels, forming a layer 18 ft. deep, were found sealed deposits in the form of a series of superimposed house structures, in which the floors had been plastered, coloured red, and burnished. There is evidence to show that the walls of these structures had been treated in a similar fashion. One of the most interesting finds, according to a dispatch reporting the results of the excavation in *The Times* of April 4, is the head of a cult image of human form made of unbaked clay, in which the eyes are represented by shells. It was found in association with sherds of Thessalian painted pottery and fragments of primitive local ware immediately below the Early Bronze Age levels. The flint industry of the neolithic levels is of the characteristic Palestinian type Although Palestine is not likely to rival Iraq in the number and intrinsic value of its archæological finds, the sense of its importance grows as further exploration brings to light cumulative evidence of the part it played as a meeting place of cultural influences from a diversity of directions

Portrait of Owen at the Natural History Museum

THE Trustees of the British Museum have received by the bequest of Mr Cyril B Holman-Hunt, who died last year, the portrait of Sir Richard Owen, which was painted in 1881 by his father, the well known artist, William Holman-Hunt, O M It has been hung on the east pier near the main entrance in the Central Hall of the Natural History Museum The picture was in the possession of the artist's daughter, Mrs Joseph, but she readily acceded to her brother's wishes as expressed in his will, and arranged for its transference from the Athenæum, where it was temporarily on loan In the picture, Owen is depicted in Hunter's gown seated in an armchair The position in the Central Hall is far from suited to a glazed picture, but it is the best at present available in the building, the trustees have, however, undertaken to provide one more satisfactory whenever the public part of the Museum is extended It is fitting that the portrait should find a place at South Kensington, because Owen was superintendent of the Natural History Departments of the British Museum from 1856 until 1884 He had therefore a great say in the planning of the new building and the allocation of space in it to the several departments, and was in control when the building was opened to the public, on April 18, 1881 Incorrectly but justifiably, he is usually known as the first director of the Museum. In addition to the distinction of the subject, the picture has considerable interest as a work of art, because the eminent artist seldom engaged in portraiture, and only about five examples of that side of his work are known

British Empire Cancer Campaign

AT the fifty-fourth meeting of the Grand Council of the British Empire Cancer Campaign held on April 10, it was announced that a grant at the rate of £350 a year for the year 1935 has been made to Sir Leonard Hill for the services of Dr T Reiter whilst continuing his research work on short wave therapy in the laboratories of the St. John Clinic and Institute of Physical Medicine On the recommendation of the Physical Sub-Committee of the Scientific Advisory Committee, a grant of £1,000 a year for two years has been made to the North of England Council of the Campaign, to be placed at the disposal of Prof. W E. Curtis, of the Armstrong College, Newcastle, and Dr. F Dickens, research director of the Cancer Research Institute of the North of England Council, for the purpose of conducting an exhaustive scheme of research in short wave therapy. A grant of £700 has been placed at the disposal of the Scientific Advisory Committee for a special investigation, under its supervision, of the biological reactions of monochromatic radiations of various wave-lengths The Grand Council has decided to continue to offer from time to time a prize and medal for the best essay submitted on a set subject concerning cancer research, gold medals will also be awarded from time to time to those in the British Empire who have carried out and published contributions to cancer research of outstanding merit

New Mount Everest Expedition

THE Mount Everest Committee announces that another Mount Everest Expedition will take place during 1935 36, with the consent of the Tibetan Government Mr Hugh Ruttledge, who led the 1933 expedition, has been offered, and has accepted, the leadership The Committee, the chairman of which is Sir Percy Cox, will in due time make an announcement of plans The first Mount Everest expedition under Col H Bury was in 1921 This was followed by a second expedition under General C G Bruce in 1922, and a third under Lieut -Colonel E F Norton in 1924 On that expedition, Mr G A Leigh-Mallory and Mr A C Irvine lost their lives in the last thousand feet of the ascent, but it is not improbable that they reached the summit The fourth expedition, in 1933, met with exceptionally bad weather conditions and was forced to abandon the attempt when success seemed to be within sight In 1933, the Houston Mount Everest expedition made a flight over the summit and secured photographs

Field Trials of Agricultural Crops

FURTHER reports of the field trials carried out in Great Britain under the auspices of the National Institute of Agricultural Botany have been published in its *Journal* (vol 3, No 3 *2s 6d*) As before, stress is laid on the necessity for carrying out the experiments at several centres simultaneously, and for repeating them for three consecutive years, before really reliable recommendations can be made The results of the trials of cereals in Essex (1927–29) are now complete 'Yeoman' and 'Yeoman II' proved by far the best of the winter wheats, and all autumn sown varieties were on an average £3 per acre more valuable than those sown in the spring As regards barley, 'Plumage Archer' was the most generally grown, although 'Spratt Archer' gave quite as satisfactory yields. Autumn sowing if successful was profitable, a gain of £2 per acre being obtained, but the risk of bad winter conditions has, of course, to be taken into account 'Grey Winter' proved the hardiest and best yielder of the winter oats grown, but both standing and yielding capacity were lower than desired Spring oats generally gave a higher yield than winter varieties. In every case the advisability of early sowing is emphasised, not later than the middle of November for autumn sowing, and during February for the spring varieties. The growing of named, rather than unknown, varieties is also of the first importance, as it may mean a difference of as much as £3–£4 per acre in the value of the return Results from potato and sugar beet trials are also given, and the publication concludes with the fourteenth annual report of the Official Seed Testing Station for England and Wales.

Humane Slaughter

IN the thirteenth annual Benjamin Ward Richardson Lecture which was delivered before the Model Abattoir Society on November 27 and has just been published, Sir Leonard Hill, who had chosen for his subject "Electric Methods of Producing Humane Slaughter", maintained that Richardson's aim for humane slaughter was fulfilled by the introduction of the electric stunning instrument, which was a safe process and free from the objections made against shooting. The current is obtained from the usual 200 volt 50 cycle A C lighting current, and is reduced to 50 volts by a transformer The electrodes, which are at the ends of the jaws of a tong like instrument, are applied for 5 seconds in the case of pigs and for 20 seconds in the case of cattle, after soaking in 20 per cent saline, one on each side of the jaw of pigs, and between the eyes and ears of calves and sheep The old method of electrocution, which caused violent contractions and even rupture of and hæmorrhage into the muscles, is avoided by this process, and no spilling of blood occurs

Geographical Methods and Earth Stucture

THE Pontifical Academy of Sciences of the Vatican City announces the offer of a prize of 10,000 lire, to be awarded for an original, unpublished thesis dealing with the utilisation of geophysical methods in the investigation of the interior of the earth Scientific men of all nationalities are invited to submit theses, five typewritten copies of which, in French, Italian or Latin, should reach the Academy before November 1 of this year No ordinary member of the Academy, whether resident in Rome or elsewhere, is eligible to compete The name of an author may be appended to his thesis or, alternatively, the authorship may be indicated by a motto or sign In the latter event, the name of the author should be enclosed in an envelope marked outside with the motto or sign A special committee, nominated by the Academy, will judge the theses submitted, and the award will be presented to the successful author at the first meeting of the next session of the Academy, to be held in December

Fifty Years of Chemical Theory

THE Liversidge Research Lecture delivered before the Australian and New Zealand Association for the Advancement of Science in January by Sir D Orme Masson dealt with "Crucial Advances in Chemical Theory during the last Half-Century". The lecture gave a brief summary of the initiation of the theory of solution and electrolytic dissociation, the discovery of the inactive elements, X-rays, radioactivity, atomic numbers and the nuclear theory of the atom, isotopes, positive rays and a generalised formula for the structure of all atoms proposed by the lecturer in 1921. The latter states that, if p is a proton, e an electron, N the atomic number and A the true integral mass of the atom, with n (necessarily integral) equal to the difference $A - 2N$, then every neutral atom may be represented by the formula $[(p_2e)_N\ (pe)_n]e_N$, in which the nucleus is enclosed in the square bracket and the external electronic system is outside it In the case of hydrogen, $n = -1$ The groups pe and p_2e have since been discovered in the neutron and the heavy hydrogen nucleus, respectively

The Ray Society

AT the annual general meeting of the Ray Society on March 20, the following officers were re-elected *President*, Sir Sidney Harmer, *Treasurer*, Sir David Prain; *Secretary*, Dr W T. Calman Prof F. E Weiss was elected a vice-president, and Mr R Adkin, Dr. Stanley Kemp, and Mr E A. Robins were elected new members of Council. In the report of the Council it is announced that the second and final volume of Prof Stephenson's work on British sea anemones is about to be issued, and it is stated that the publication of this finely illustrated and costly work has been rendered possible by contributions from the Government Grant Fund of the Royal Society, and from several private donors, among whom Mr J Spedan Lewis is specially mentioned It is announced that the issue to subscribers for the current year will be the first volume of a work on British Neuroptera by Mr. F. J. Killington.

Thunderstorm Survey

MR S MORRIS BOWER, of Langley Terrace, Oakes, Huddersfield, informs us that the annual survey of thunderstorms in the British Isles which he has instituted will be continued during the coming summer Mr. Bower will be glad to receive details as to the place, date and time of the occurrence of thunder, lightning or hail Records of damage by lightning will also be especially welcome. The space and time distribution maps of thunder have recently thrown useful light on the question of storm travel, and on its association with meteorological and geographical considerations. The areas of greatest damage by lightning are not necessarily those of maximum storminess, and in view of the value of the determination of such areas in electric power transmission, it is proposed to pay particular attention to this aspect of the survey.

Benefaction for Research into Short-wave Therapy

THE Medical Research Council has agreed to act as trustee in administering a benefaction of £4,000 provided by the Stock Exchange Dramatic and Operatic Society and named in honour of the secretary of the Society, Mr. Hugh S. Quekett. The purpose of the gift is the promotion of research into the value of short-wave radiation in the treatment of disease. The money will be used by the Council to meet the cost of assistance and special apparatus in experimental and clinical investigations to be made at the London Hospital under the direction of Prof. D. T. Harris, Dr. E May, and Sir Robert Stanton Woods.

First Shipment of Petrol from Billingham

PENDING the completion of the erection of the plant for the direct hydrogenation of coal, the first shipment of petrol, some 300,000 gallons, produced by the hydrogenation of creosote at the Billingham plant of Imperial Chemical Industries Ltd., has been loaded into the s.s. *Otterhound*, at Billingham. The petrol is being delivered to the Shell-Mex-B.P. Company which, with the Anglo-American Company, are undertaking distribution on behalf of the producers. This delivery initiates regular traffic between Billingham and east coast ports of Great Britain.

Announcements

PROF. F. G. DONNAN, professor of general chemistry in the University of London, has been elected an honorary member of the Chemical Society of Rumania. Prof. Donnan has also been invited by the Danish Natural Science Association to give three lectures in Copenhagen during the week beginning May 20.

HIS MAJESTY THE KING has approved the award of the Royal Medals of the Royal Geographical Society as follows: Founder's Medal to Major R. A. Bagnold, for his journeys in the Libyan Desert; Patron's Medal to Mr. W. Rickmer Rickmers, for his long-continued travels in the Caucasus and Russian Turkistan culminating in his leadership of the Alai-Pamir Russo-German Expedition of 1928. The Council has awarded the Victoria Medal to Mr. E. J. Wayland, for his work on the Quaternary geology of Uganda and the Rift, and its relation to man.

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to Mr. Alfred Chester Beatty, in recognition of his distinguished services to the mining industry in the development of mineral deposits, with particular reference to the copper resources of Northern Rhodesia. The following awards have also been made: the Consolidated Gold Fields of South Africa Ltd. Gold Medal to Dr. David Williams, for his geological researches and for his paper on "The Geology of the Rio Tinto Mines, Spain"; the Consolidated Gold Fields of South Africa Ltd. Premium of forty guineas to Mr. William Henry Wilson, for his paper on "The Tri-dimensional Projection of Mine Workings"; the Arthur Claudet Students Prize of ten guineas to Mr. Charles Patrick McMillan, for his paper on "Milling Methods and Costs at the Alaska Mine Flotation Plant of the Southern Rhodesia Base Metals Corporation, Limited, Southern Rhodesia"; the William Frecheville Students Prize of ten guineas to Mr. James G. Traill, for his paper on "The Relation between Width and Cost in Narrow Stopes".

MR. B. H. ST. JOHN O'NEIL has been appointed inspector of ancient monuments for Wales. He has been assistant inspector of ancient monuments for Wales since 1930.

THE following have been elected officers of the Royal Aeronautical Society for 1935-36: *President*, Lieut.-Colonel J. T. C. Moore-Brabazon; *Vice-President*, Mr. H. E. Wimperis; *New Members of Council*, Major T. M. Barlow, Major G. P. Bulman, Dr. H. Roxbee Cox, Prof. G. T. R. Hill, Dr. N. A. V. Piercy; *Honorary Treasurer*, Major D. H. Kennedy; *Honorary Librarian*, Mr. J. E. Hodgson.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. F. C. Jessop, to be adviser in animal husbandry, Department of Agriculture, Malta; Mr. J. B. Polding, to be veterinary pathologist, Malta; Mr. R. N. Twisleton-Wykeham Fiennes, to be veterinary officer, Uganda; Mr. H. C. King (late assistant conservator of forests, Ceylon), to be assistant conservator of forests, Mauritius; Mr. F. B. Wade (senior assistant geologist), to be Government geologist, Department of Lands and Mines, Tanganyika; Mr. E. B. L. Colborne, to be engineering chemist, Public Works Department, Gold Coast.

IT is probable that the Challenger Society will be making further grants in aid of research during the year 1935-36. The General Committee is prepared to consider applications for small grants in aid of research in marine biology at a recognised laboratory during the current year. Applications, accompanied by details of the proposed research, should reach the Honorary Secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the end of April.

THE original autograph manuscript of Alcide d'Orbigny's celebrated work "Foraminifères" which formed part of Ramon de la Sagra's "Histoire Physique, Politique et Naturelle de l'Île de Cuba" (Paris, 1839), has been acquired for, and added to, the Heron-Allen Library of Foraminiferal Research at the British Museum (Natural History).

PROF. A. Wolf's work on the beginnings of modern science and technology will be published shortly by Messrs. Allen and Unwin, Ltd., under the title "A History of Science, Technology and Philosophy in the Sixteenth and Seventeenth Centuries". The book is a comprehensive account of one of the most interesting scientific periods in the world's history, and is profusely illustrated from old prints.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Engineers for the Building Research Station, Garston, and two junior scientific officers at the Road Research Laboratory, Harmondsworth—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 17). A teacher of mechanical engineering in the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (April 18). A lecturer in zoology in the University of Capetown—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (April 30). An assistant lecturer in mechanical engineering in the University of Sheffield—The Registrar (May 3). An analyst and demonstrator at the Harper Adams Agricultural College, Newport, Shropshire—The Principal. A director of pathology and Lyle research scholar at Queen Mary's Hospital for the East End, Stratford, E.15—The Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 587.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radiopotassium and other Artificial Radio-elements

IN a letter published in NATURE of January 19, it was shown that the bombardment of scandium with neutrons leads, beside the formation of an active scandium isotope[1] ${}_{20}\mathrm{Sc}^{46}$, to the formation of a new potassium isotope ${}_{19}\mathrm{K}^{42}$ having a half life value of about 16 hours and emitting β rays the intensity of which is reduced to one half of its initial value by an aluminium foil of approximately 0·7 mm thickness. We were recently successful in preparing this potassium isotope K^{42} by the bombardment of calcium by neutrons according to the equation

$$ {}_{20}\mathrm{Ca}^{42} + {}_{0}n^{1} = {}_{19}\mathrm{K}^{42} + {}_{1}\mathrm{H}^{1} $$

Calcium carbonate, after being exposed to neutrons produced by a mixture of 200–300 mgm. radium emanation and beryllium powder, was dissolved in dilute hydrochloric acid, 150 mgm. sodium chloride added and the calcium precipitated as oxalate. The filtrate was found to be active and the measurement of both the rate of decay and the absorption of the radiation emitted has shown the presence of ${}_{19}\mathrm{K}^{42}$. The yield of K^{42} from calcium is a low one, which is due chiefly to the fact that the isotope Ca^{42} is only present to the extent of 0·8 per cent in the mixed element calcium. It is now possible to produce the potassium isotope K^{42} by each of the following reactions:

$$ (1)^{2}\ {}_{19}\mathrm{K}^{41} + {}_{0}n^{1} = {}_{19}\mathrm{K}^{42}, $$
$$ (2)\ {}_{20}\mathrm{Ca}^{42} + {}_{0}n^{1} = {}_{19}\mathrm{K}^{42} + {}_{1}\mathrm{H}^{1}, $$
$$ (3)\ {}_{21}\mathrm{Sc}^{45} + {}_{0}n^{1} = {}_{19}\mathrm{K}^{42} + {}_{2}\alpha^{4}. $$

When applying neutrons slowed down by Fermi's device by reflection by hydrogen nuclei, an active calcium isotope was obtained which decays with a period of 4 hours, the formation of which is due to one of the following two reactions:

$$ {}_{20}\mathrm{Ca}^{40} + {}_{0}n^{1} = {}_{20}\mathrm{Ca}^{41}, $$
$$ {}_{20}\mathrm{Ca}^{44} + {}_{0}n^{1} = {}_{20}\mathrm{Ca}^{45}; $$

the latter being the more probable one.

We investigated also the action of neutrons the velocity of which was reduced by the use of paraffin, on zirconium and hafnium, and found that the active zirconium obtained decays with a period of 40 hours, the intensity of the β-rays emitted being reduced to one half of its initial value by an aluminium foil of 0·5 mm thickness. The disintegration of the active hafnium is much slower than that of zirconium, half of the activity acquired being lost only after the lapse of a few months. Radio-zirconium is presumably formed according to the equation

$$ {}_{40}\mathrm{Zr}^{96} + {}_{0}n^{1} = {}_{40}\mathrm{Zr}^{97} $$

In the case of hafnium, every place between the mass numbers 176 and 180 being occupied by a known stable isotope, the formation of the active hafnium isotope can only be due to the process

$$ {}_{72}\mathrm{Hf}^{180} + {}_{0}n^{1} = {}_{72}\mathrm{Hf}^{181} $$

On emitting β-rays, according to the equation,

$$ {}_{72}\mathrm{Hf}^{181} = {}_{73}\mathrm{Ta}^{181} + \beta, $$

the active hafnium isotope becomes the only stable isotope of tantalum known.

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HILDE LEVI.

Institute of Theoretical Physics,
Copenhagen.
March 15.

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[1] cf. G. Hevesy, *Proc. Roy. Danish Acad.*, Feb. 3, 1935.

[2] Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti and Segré, *Ricerca Scientifica*, Dec. 2, 1934.

Extension of the Ultra-Violet Wave-Length Limit

THE best light source for the spectroscopy of the extreme ultra-violet region is the hot spark. In the spectroscopic work at this Institute, the electrodes of the spark are usually connected through short straight leads to four condensers having a capacity C of 0·4 μF together. These are charged to a tension $V = 50$–70 kv. The discharge through the spark is periodic with a period T of about 8 μ sec. (corresponding to a wave-length of 2,400 metres). The maximum current in the spark is

$$ i_{\max} = V\sqrt{\frac{C}{L}} = 2\pi\,\frac{CV}{T}. $$

If in our case, $V = 50$ kv., we have $i_{\max} = 16{,}000$ amp. If we wish to increase the current in the spark we have to increase the tension V, which is possible only to a certain extent. Further, we can increase the capacity C, but this gives a rather slow increase in i. Finally, we can decrease the inductance in the circuit.

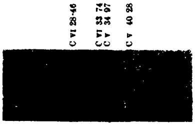

FIG. 1. Spectrum of spark between carbon electrodes. Time of exposure ½ hour. Focused at about 30 A.

Now the straight leads from the condensers to the spark do not give the minimum inductance. In fact, if we 'cable' the leads so that the current flows in the interior of a cable in one direction and returns on the outside of the cable, the resulting inductance decreases considerably.

We have connected each of the four 0 1 μF condensers through three cables to the electrodes of the spark This diminishes the resulting inductance to almost 0·1, so that the period decreases to one third and the maximum current increases three times. At 50 kv we then have $i_{\max} \sim 47{,}000$ amp (if the discharge is still periodic)

We have investigated the spectroscopic effect of this increase in the spark current with the help of a concave grating spectrograph having the plate at right angles to the Rowland circle[1] The grating had a radius of 1,800 mm and was ruled at this institute with 288 lines a millimetre The angle of incidence was 1 65°

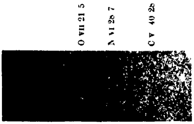

FIG 2 Spectrum of spark between carbon and carbon + lithium nitrate electrodes Time of exposure 2½ hours Focused at about 20 A

With the condensers connected in the usual way, we have obtained with graphite electrodes the C v-line at 40 A rather well The C v line at 34 A and the C VI-line (the first line of the Lyman series) at 33 A were faint but visible after half an hour's exposure

When the condensers were 'cabled', the intensity of these lines increased very much, especially the C VI-line Moreover, the second Lyman line of C VI at 28 A was detected

When some lithium nitrate was placed in one of the carbon electrodes, the first N VI-line at 28 A and the first O VII-line at 21 A. became visible after about 1 hour With aluminium electrodes, some Al XI-lines down to 38 A appeared

Thus the short wave limit of the ultra-violet has been extended from 33 A [2] down to 21 A

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Feb 20

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[1] M Söderman Diss, Uppsala, 1934

[2] Manne Siegbahn and M Söderman, NATURE, 129, 21, 1932

Magnetic Properties and Critical Currents of Supra-conducting Alloys

IN previous papers[1] we reported that, in the stable state of supra-conducting lead, the induction B is always zero. We shall now discuss measurements carried out with a lead–thallium alloy corresponding in composition to $PbTl_2$ and an alloy of 65 per cent lead and 35 per cent bismuth. The measurements were made at various temperatures with the method we have previously described (method No. 2)[2].

In Fig. 1 is shown the relation between induction B and field-strength H for $PbTl_2$ at $T = 2{\cdot}11°$ K The experiments show that

(1) Up to a definite critical field-strength H_{k_1}, which depends on the temperature, B remains nearly zero In this region the behaviour of alloys and pure metals is the same

(2) In the field interval from H_{k_1} to H_{k_2}, the induction increases with the field strength, gradually approaching the value characteristic for the non-supra-conducting metal Electrical measurements carried out on wires from the same melt showed that the potential difference remains equal to zero right up to the field strength H_{k_2} In the field interval from 0 to H_{k_2} the induction is independent of time

(3) At the second critical field-strength H_{k_2}, which is 1700 gauss at $T = 2\ 11°$, the alloy loses its supra conductivity The magnetic properties undergo no change at this point

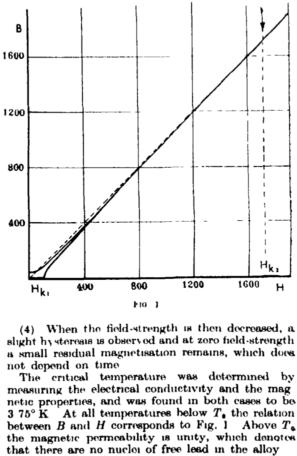

FIG 1

(4) When the field-strength is then decreased, a slight hysteresis is observed and at zero field-strength a small residual magnetisation remains, which does not depend on time

The critical temperature was determined by measuring the electrical conductivity and the magnetic properties, and was found in both cases to be 3 75° K At all temperatures below T_0 the relation between B and H corresponds to Fig. 1 Above T_0 the magnetic permeability is unity, which denotes that there are no nuclei of free lead in the alloy

The experiments with the Pb–Bi alloy gave qualitatively similar results

We have already published measurements on the specific heat of the lead-bismuth alloy[3] showing that no appreciable jump in the specific heat was observed at T_0 Thus the specific heat and the magnetic measurements are not in agreement with Gorter's theory[4].

Finally, we can report on some measurements of the critical electric current in the $PbTl_2$ alloy which destroys supra-conductivity Wires of this alloy 0·71, 0·33 and 0·26 mm in diameter were prepared The appearance of a resistance was observed as the current was gradually increased. The experiment was performed at various temperatures. We found that supra-conductivity is destroyed when the magnetic field at the surface of the wire reaches a definite critical value The critical field-strength caused by the current is slightly less than H_{k_1}

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Kharkov

[1] J N Rjabinin and L W. Shubnikow, *Sov Phys*, 5, 641, 1934 NATURE, 134, 286, 1934 *Sov Phys*, 6, 557, 1934 NATURE, 135, 109, Jan 19, 1935

[2] J N Rjabinin and L W Shubnikow, NATURE, 134, 286, 1934 *Sov Phys*, 6, 557, 1934

[3] L W Shubnikow and W J Chotkewitsch, *Sov Phys*, 6, 605, 1934

[4] C J Gorter, *Arch Mus Teyler*, 7, 378, 1933

Thermal Rotations of Fluorescent Molecules and Duration of Luminescence

IMPROVED fluorometer measurements, to be published elsewhere in detail, of the duration of luminescence τ of dye molecules yielded an unexpected result, in that τ for fluoresceine in water or ethyl alcohol solution was found to be apparently greater than that in glycerine solution. This is contrary to theoretical expectations, according to which τ should be approximately proportional to the fluorescence efficiency, and it is known that this is rather greater for glycerin than for water solutions

It seems, however, that the effect of thermal rotations of the dye molecules can account for this effect The rotations of the molecules excited, for example, by polarised light, tend as is well known to equalise the values of all intensity components This accelerates the decay of the intensity component I_1 parallel to the incident light vibrations and prolongs it for the perpendicular component I_2 As a result of this, there is an increase of the degree of depolarisation from its value ρ_0 for non-rotating molecules to $\rho > \rho_0$ On the basis of F Perrin's theory of polarised fluorescence[1], we have been able to deduce the following formulæ for the time of decay of I_1 and I_2.

$$I_1=\frac{I_0}{3}\left[1+2\rho_0+2\,(1-\rho_0)\exp\left(-\frac{3\,(\rho-\rho_0)}{\tau\,(1-\rho)(1+2\rho_0)}\,t\right)\right]\cdot\exp\left(-\frac{t}{\tau}\right), \tag{1}$$

$$I_2=\frac{I_0}{3}\left[1+2\rho_0-(1-\rho_0)\exp\left(-\frac{3\,(\rho-\rho_0)}{\tau(1-\rho)(1+2\rho_0)}\,t\right)\right]\cdot\exp\left(-\frac{t}{\tau}\right), \tag{2}$$

where I_0 is the value of I_1 for $t = 0$. The full argument will appear elsewhere

From equations (1) and (2), it appears that the rates of decay are not exponential, but that they are a sum or a difference of two exponential functions. Only for $\rho = 1$ or $\rho = \rho_0$ are they exponential and corresponding to the mean life period of the excited molecules In all other cases, for $\rho_0 < \rho < 1$, I_1 decays faster and I_2 slower than $e^{-t/\tau}$. As mentioned above, experiments have shown that for I_1 the observed time of decay τ_{obs} of fluoresceine in glycerine solution is smaller by about 20 per cent than that for a water solution where $\rho = 1$ For I_2, however, the difference between the τ_{obs} for water and glycerine solutions is within experimental errors, which were about 5 per cent.

Fig 1 shows τ_{obs} for I_1 and I_2 for fluoresceine as a function of ρ in different glycerine – water mixtures

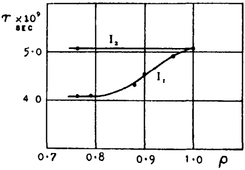

FIG 1

Although for I_2 the differences between τ_{obs} for water and glycerine solutions are within the limits of experimental error and therefore cannot be at present detected experimentally, it seems that the hypothesis put forward above can give at least a qualitative explanation of the phenomena observed

A JABŁOŃSKI
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Jan. 25.

[1] F Perrin, *J Phys*, VI, 7, 390, 1926.

Polymerisation of Formaldehyde

EXPERIMENTS on the autoxidation of gaseous formaldehyde (at 100° C) in the light of the mercury arc showed the existence of a rapid induced polymerisation, which continued unabated as a dark reaction on switching off the light No oxidation occurred during this 'dark reaction'.

The cause was traced to the formation of formic acid in the illumination period It was then found that the addition of small amounts of formic acid vapour to pure formaldehyde gas precipitated a rapid and complete polymerisation of the latter, the rate of which was uninfluenced by light. The pressure – time curves showing the progress of the polymerisation with varying concentrations of added formic acid are compared in Fig 1. Whereas, even at so high an initial pressure of formaldehyde as 500 mm. of mercury, the thermal polymerisation normally proceeded only at a rate of about 16 mm per hour, when 34 mm. of formic acid was present, the pressure fell at an initial rate equivalent to 2,295 mm. per hour—some 140 times as fast.

The apparatus used for these experiments contained a stopcock and a ground joint connecting the quartz reaction vessel to the glass portion of the system (which was electrically heated). Neither of these could be directly heated, and it was observed that the solid polymer separated mainly at the cold part. Experiments performed in a completely heated glass system, however, confirmed the observations made in the first apparatus—except that in this case there was a residual pressure, due probably to the presence of a gaseous polymer, and the solid polymer separated out on the hot wall.

The order of the reaction is approximately unimolecular over most of the range, and the rate is not appreciably affected by packing the vessel with quartz tubes. The formic acid does not appear to be used up appreciably during the reaction, titration showing that practically as much remained at the end as was introduced initially

Detailed considerations of these experiments have led us to the view that the polymerisation of formaldehyde, induced by formic acid, proceeds by a chain mechanism, in which the starting of reaction chains and also the branching are controlled kinetically by the formic acid

The results suggest that it is probable that the stability of monomeric formaldehyde depends mainly upon its freedom from traces of formic acid vapour.

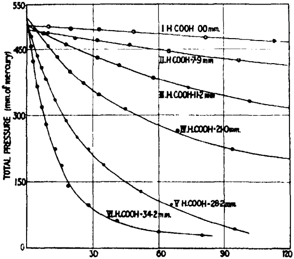

FIG 1 Polymerisation of formaldehyde catalysed by formic acid

We have found, further, that acetic acid is efficient as a polymerising agent, while preliminary experiments with acetaldehyde vapour at room temperature show that a similar polymerisation may be induced by formic acid. In this case the pure aldehyde appeared to be perfectly stable, but addition of 25·3 mm. of formic acid vapour to 298·2 mm. of acetaldehyde caused the pressure to fall at an initial rate of about 2 mm. per minute, and brought about a total diminution of pressure amounting to 162·7 mm. of mercury

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Jan. 27

Concentration and Ionising Tendency of Carboxylic Acid Groups in Cellulose and other Natural Products

CELLULOSE which has been subjected to oxidation with an alkaline oxidant is presumed to contain carboxylic acid groups, but does not show acid characteristics of the order usually associated with this group. The reason for this is that, whilst the carboxylic acid groups are ionised *within the cellulose phase*, the hydrions are unable to escape into external water, since the anions form part of the cellulose lattice.

A theoretical consideration of the ionic equilibria in the system 'oxycellulose' – dyestuff – water led to the expectation that the constraint on the movement of the hydrions would be overcome by the addition of a neutral electrolyte Indeed, if the Donnan theory of membrane equilibrium is applicable, in presence of excess sodium chloride, the concentration of sodion, and therefore that of hydrion, in the external solution should become equal to the respective concentrations within the fibre

A qualitative experiment showed in a striking manner the existence of this effect. A sample of 'oxycellulose', washed until the washings were neutral, was placed in water and methyl red (*p*H 4·2–6·3) added The colour changed slowly towards a final *p*H of 5, on account of interchange between the indicator sodions (present in very low concentrations) and the carboxylic acid hydrions When sodium chloride was added a very marked further change took place Acid 'streamed' out the fabric and in a few seconds the colour indicated a *p*H below 4

In the presence of excess sodium chloride, 'oxycellulose' becomes sufficiently acid to be titrated directly with sodium hydroxide, using an indicator turning slightly on the acid side of the neutral point A ready method of determining the content of carboxylic acid groups is thus provided Moreover, by the determination of the change of *p*H with salt concentration, it should be possible to evaluate the ionisation constant of the carboxylic acid groups

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Feb 27

A New Type of Anomodont Reptile

IT is almost a hundred years since the first Anomodont reptile was discovered in South Africa by Andrew Geddes Bain This skull was sent to Owen and in 1844 he described it under the name *Dicynodon lacerticeps* Numerous other *Dicynodon* skulls were afterwards sent to London and are now in the British Museum (Natural History) The typical *Dicynodon* is very mammal-like in much of its structure, but is remarkable in having had a horny beak something like that of the tortoise, with in addition in the male a powerful permanently growing tusk in each maxilla and no other teeth

During the latter half of the nineteenth century many species of *Dicynodon* were described, and a number of other genera more or less allied to it, and in the last thirty years our knowledge has increased so greatly that we now know about 130 species of *Dicynodon* and its allies These are grouped in an order called the *Anomodontia* Some have tusks in both sexes · some have no tusks in either sex Some have a row or a number of rows of molar teeth. But all agree in that the premaxillaries are fused to form a beak, and hitherto no species has been known in which there are any teeth in the premaxillaries.

A couple of months ago I discovered in beds of the *Endothiodon* zone of the Karroo an imperfect little skull, which on being developed reveals a new type of palate in that there is a number of teeth on the premaxillaries. In many respects the skull resembles that of some of the small Endothiodonts, such as *Cryptocynodon* of Seeley, or *Prodicynodon* or *Emyduranus*; but the presence of at least seven teeth on each premaxilla separates it markedly from all previously known *Anomodonts*. These teeth are not like incisors, growing from the front of the bone, but are fixed in the back of the fused premaxillaries as shown in Fig 1.

This new type of Anomodont I propose to name *Eumantellia mirus*, after Gideon A Mantell, one of the greatest of our early palæontologists, and chiefly remembered by his discovery of *Iguanodon*

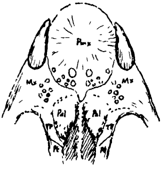

FIG 1 Palate of *Eumantellia mirus*, g et sp nov
Natural size

Though *Eumantellia* is too late in time to have been the ancestor of the Dicynodonts and the Endothiodonts, it must be morphologically very near to the common ancestor The loss of the premaxillary teeth would result in a primitive Endothiodont such as *Prodicynodon*, and the further loss of the molars would result in a primitive Dicynodont Possibly we may yet discover an earlier type with an unspecialised premaxillary, and incisor teeth in front

It is manifest that *Eumantellia* must be placed in the Anomodontia, but it seems necessary to make it the type of a new family Eumantelliidæ

R BROOM.

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South Africa

Retinoscopy of *Loris*

IN connexion with a study on the affinities of the lorisiform Primates, I have had the opportunity, through the kindness of Prof F O'B Ellison, of the Physiology Department of this College, of examining the retina of the living Slender loris with the aid of a Gullstrand large simplified ophthalmoscope.

An adult female animal was placed under very slight ether anæsthesia, sufficient to enable the head to be manipulated freely into the desired position Two drops of 1 in 10,000 atropin solution were placed in one eye This dilated the pupil fully in a few minutes, the other pupil remaining contracted in its normal slit-like condition The instrument was easily focused on the retina and the animal did not move the eyeball about unduly during the examination

The retina gave a very brilliant reddish golden reflex with minute scintillating spots due to the presence of a tapetal layer. This masked the detail somewhat, but was overcome by the use of a green filter. The optic disc consisted of a very darkly pigmented central area, surrounded by a paler ring and then by a marginal zone of lighter pigment From the disc emanated six large vessels and some smaller delicate ones There were three temporal vessels, upper, middle and lower, and likewise three on the nasal side A fair-sized vessel corresponding in position to a macular artery arose from the disc between the middle and lower temporal vessels This artery passed transversely outwards and divided into two branches, the upper of which crossed over a branch of the middle temporal vessel and then returned again No spot where the retina was differentiated to form a macula could be seen This does not preclude the possibility, however, that on microscopic examination of sections a primordium maculæ such as has been described by Woollard[1] in *Tarsius* may not be found

There are in the peripheral parts of the retina of *Loris* a number of small transversely running vessels One of these at least appeared to be an anastomotic channel between the lower temporal and the lower nasal vessels The central artery of the retina in *Loris* therefore is not an end-artery in the anatomical sense.

W C. OSMAN HILL

Anatomy Department,
Medical College,
Colombo, Ceylon
Feb 14

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[1] Woollard, H H, "The Retina of Primates" *Proc Zoo Soc*, 1927

Cystine and Protein Relationship of Grasses

AN interesting relationship between the cystine content and the protein content of grasses collected through different periods of the year has been established A coefficient of correlation of + 0 923 for 10 pairs, indicating an almost perfect relationship between the protein content and the cystine content of the grasses throughout the year, is demonstrated The accompanying curves (Fig. 1) show a marked fall in both the protein and cystine contents of the grasses through the winter months, with a corresponding rise of both during the commencement of the rainy season during September and October As would be expected, the rainfall curve shows a fair correlation between protein and cystine contents

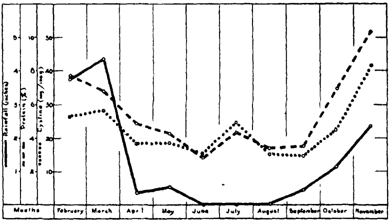

FIG. 1

The grasses were collected at random during ten successive months from the University of Pretoria farm in 1932. The protein analyses were carried out by Mr. F. N. Bonsma at the University of Pretoria and the cystine analyses were undertaken at this laboratory. The method for the latter was based on a modification of the cuprous-mercaptide precipitation described by Rossouw and Wilken-Jorden in the *Biochemical Journal* All material was dried at 103° C

S D ROSSOUW

Wool Research Section,
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Feb 20

Interaction of Radio Waves

PRIOR to the observation of the interaction of radio waves[1], the study of the propagation of such waves through the atmosphere was concerned only with the effect of the ionosphere on them The converse effect, namely, the influence of electric waves on the ionosphere, has already been considered by us in a theory of radio interaction[2]

One of the stated consequences of our theory is that the modulation M, impressed by the interfering wave on the wanted wave, is proportional to $1/\sqrt{(f^2+780^2)}$, where $f/2\pi$ is the modulation frequency of the interfering wave; that is, the impressed modulation should be distorted in favour of the lower frequencies.

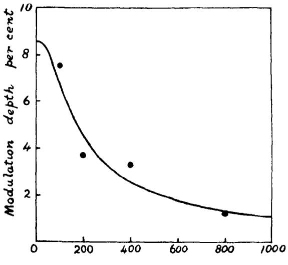

FIG 1

There were in Australia no stations sufficiently powerful to allow us to verify this prediction, but its truth has been since confirmed by many observers in Europe, notably Drs. B. van der Pol and J. van der Mark[3] and several members of the World Radio Research League.

The quantitative observations of Drs van der Pol and van der Mark give strong support to our theory, as may be seen in the accompanying diagram (Fig. 1) where the black dots represent the observed values of the 'depth of modulation' with different modulation frequencies, and the smooth curve represents the formula $y = 670/\sqrt{(f^2+780^2)}$.

The number 780 which occurs in the denominator is the product of two factors, G and ν, the values of which were derived by us respectively from the investigations of Townsend and Tizard on the motions of electrons in air and from the estimates made by Appleton and Chapman of the collision frequency ν in the Heaviside layer Thus the observations of van der Pol and van der Mark are consistent with the conclusions of the above mentioned investigators.

V A BAILEY

University of Sydney

D F MARTYN.

Commonwealth Radio Research Board,
Australia

[1] A G Butt, *World Radio*, April 28, 1933 B D H Tellegen, NATURE, **131**, 840, 1933

[2] NATURE, **133**, 218 1934 *Phil Mag*, Aug 1934

[3] In a report presented to the Union Radio Scientifique Internationale and dated September 10, 1934

Frequency of Collision of Electrons in the Ionosphere

WE were much interested in a recent communication[1] in which Mr. T. L Eckersley described the way in which he had measured the collisional frequency of electrons in the F_1 region of the ionosphere by comparing the absorption coefficients and group retardations of returned echoes It is a well-known fact that the effects of the F_1 region are only evident during the hours of daylight, and this presumably accounts for the fact that Mr Eckersley's observations were made between 1550 and 1630 hr, that is, about one hour before sunset

Recent experiments have led us to the conclusion that waves reflected from the F region are appreciably absorbed in the E region during the day, and that this E region absorption decreases rapidly near sunset This view is not in agreement with that of Mr Eckersley, who considers[2] that F region echoes are not appreciably absorbed in the E region In accordance with our view, therefore, we do not consider that Mr Eckersley is justified in neglecting the decrease of E region absorption during the course of his experiment, and it is our opinion that experiments of this kind should only be done at times when either (i) there is no absorption in the E region, that is, at night, or (ii) when the E region absorption is not changing with time, that is, about 1400 hr, the time of maximum E region absorption

Working with these points in mind, we have been using a method of the same kind as that described by Mr Eckersley to investigate the F_2 region, but we have restricted our observations to the two times mentioned above (for the F_1 region observations are possible at all times of day or night) In October of last year we found the average value of the collisional frequency to be 1·6 × 10^3 per electron per second

F T FARMER
J A RATCLIFFE.

Cavendish Laboratory,
Cambridge
March 18

[1] NATURE, **135**, 435, March 16, 1935

[2] *Proc Roy Soc*, **141**, 710, 1933

Linkage of Chemical Changes in Muscle

WE should like to report some experiments which form an extension of those recently described by Parnas[1], and his colleagues. These workers, using muscle *brei* poisoned with iodoacetic acid, found that synthesis of creatine phosphate could go on, provided that phosphoglyceric acid was added to the *brei*. Breakdown of phosphoglyceric acid can only proceed if adenylic acid or adenylpyrophosphate is present, and the synthesis of creatine phosphate was only observed during the short interval of time before the complete deamination of the co-enzyme in the iodoacetic acid *brei*.

Our experiments were carried out with dialysed muscle extracts, which have the advantage of containing no carbohydrate or carbohydrate breakdown products, so that the addition of poison is unnecessary in showing the phosphoglyceric acid effect. When phosphoglyceric acid (0 14 mgm phosphorus per c c extract mixture), adenylic acid and creatine were added to such an extract of frog muscle (buffered at *p*H 7·2 with bicarbonate and phosphate), after 1 hour at 18° C, about 20 per cent of the phosphoglyceric acid phosphorus had appeared as creatine phosphate phosphorus, and about 60 per cent as inorganic phosphorus. Controls showed that no creatine phosphate and no increase in inorganic phosphate appeared in the absence of adenylic acid, whether or not creatine was present Creatine cannot therefore dephosphorylate phosphoglyceric acid without the help of the adenylic compounds

Results similar in most respects were obtained with rabbit muscle extract, which showed greater activity Changes in pyrophosphate content were also estimated here After 1 hour at 18° C, of 0·14 mgm phosphoglyceric acid phosphorus added per c c of the extract mixture, 80 per cent had disappeared, 20 per cent appearing as phosphagen phosphorus, 25 per cent as adenylpyrophosphate phosphorus, and 20 per cent as inorganic phosphorus In an experiment with a lower concentration of adenylic acid, as much as 44 per cent appeared as phosphagen phosphorus Even after 2 hours standing at 37° C. and 6 hours dialysis at 0° C, addition of phosphoglyceric acid and creatine to the rabbit extract gave a small phosphagen synthesis, and breakdown of about 50 per cent of the phosphoglyceric acid. It is likely that this effect is due, not to the dispensability of adenylic acid, but to the extreme difficulty of removing it completely from rabbit muscle extract.

None of the extracts showed any phosphagen synthesis when adenylic acid and creatine were added and phosphoglyceric acid omitted. In all cases, when phosphoglyceric acid phosphorus disappeared, the formation of pyruvic acid was observed.

The theoretical implications of these results have been discussed by Prof Parnas. We ourselves incline at present to the view that reaction first takes place between adenylic acid and phosphopyruvic acid (formed as an intermediate between phosphoglyceric acid and pyruvic acid), and that the resulting adenylpyrophosphate then reacts with creatine (reverse Lohmann reaction), but further work is needed here. Adenylpyrophosphate apparently not only reacts with creatine, but also breaks down into adenylic acid and *free* phosphate, so that exhaustion of the phosphoglyceric acid supply would lead ultimately to the disappearance of adenylpyrophosphate, and of creatine phosphate also by Lohmann's reaction with adenylic acid

We are indebted to Prof. O. Meyerhof for the specimen of phosphoglyceric acid used

D. M. NEEDHAM.
W E VAN HEYNINGEN.

Biochemical Laboratory,
Cambridge.
Feb. 28.

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[1] NATURE, 134, 627; 1934 *ibid.*, 134, 1007, 1934. *Biochem. Z.*, 272, 64; 1934. *ibid*, 275, 74; 1934

Interpretation of Fermat's Principle

IN order to demonstrate the possibility that an optical path between two fixed points may be merely stationary, that is, neither maximum nor minimum, Mr. T. Smith[1] includes in the infinite number of paths with which an actual path is to be compared those which in one homogeneous medium are non-rectilinear. Thus in Fig. 1, if A' is the image of A due to the lens PQ, the actual path $APA'B$ is compared with the longer and shorter imaginary paths $APCB$ and $AQDB$.

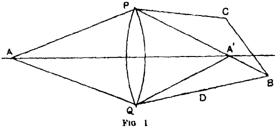

FIG 1

Fermat's Principle, stated in the form "The optical path of a ray from one fixed point to another is stationary", excludes from consideration all rays such as PCB which in one homogeneous medium are non-rectilinear. Hamilton[2], more than a century ago, demonstrated rigorously that "the property of *stationary length* belongs (in free space) to straight lines and to such only". Presumably, it is neglect of this fact which leads Mr. Smith to state "It is clearly a trivial matter to demonstrate that no given optical path is ever a maximum". The usual demonstrations of the possibility of maximum paths on reflection or refraction by consideration of aplanatic surfaces[3] are not, as Mr Smith suggests, erroneous.

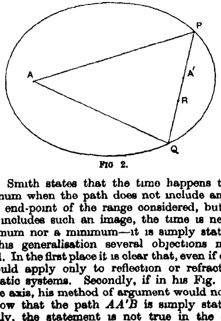

FIG 2.

Mr Smith states that the time happens to be a minimum when the path does not include an image of an end-point of the range considered, but if the path includes such an image, the time is neither a maximum nor a minimum—it is simply stationary. To this generalisation several objections may be raised. In the first place it is clear that, even if correct, it would apply only to reflection or refraction by aplanatic systems. Secondly, if in his Fig. 1, B is on the axis, his method of argument would not serve to show that the path $AA'B$ is simply stationary. Thirdly, the statement is not true in the case of reflection by an elliptical mirror of light from a point source at a focus. The path APR (Fig. 2) contains the image A' but it is not simply stationary, it is the maximum, and AQR is the minimum, of all paths from A via the mirror to R.

The application of Fermat's Principle to paths through non-aplanatic systems generally involves a lengthy mathematical procedure A relatively simple case is that in which the end-points are on the axis of a refracting sphere. When the end-points are equidistant from the sphere, the actual non-axial paths are merely stationary while the corresponding axial paths are minima.

O DARBYSHIRE

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[1] NATURE, 133, 830, 1934

[2] *Dublin Univ Review*, p 795, Oct 1833 Mathematical Papers, 1, 311, 1931

[3] Drude, "Theory of Optics", 9–11, 1902

IN the wave theory of light, the 'geometrical' laws of optics—rectilinear propagation, reflection and refraction—and other results besides, rest on a single principle. The fundamental postulate is that any train of waves may be replaced by a sheet of sources of suitable intensities and phases, that is, paths such as APCB of Fig 1 of Mr Darbyshire's letter are to be taken into consideration equally with paths like AQDB Of all possible paths, the 'rays' of geometrical optics are found to be stationary paths and so suitable for phase calculations; this is the essence of Fermat's Principle.

Of the specific objections Mr Darbyshire raises: the first rests on an unnecessary restriction of 'image' By this term we ought to understand any point where the wave system exhibits a singularity, this normally corresponds to the re-intersection of any two neighbouring rays arising from the same object point As regards the second, I have *assumed* the stationary property throughout, and the reasoning used is, I think, generally applicable with a symmetrical system As to the third objection, which has been mentioned by other physicists also, it may be observed that, according to geometrical optics, APR and AQR are the only possible paths between A and R for a single reflection, and the labelling of two isolated paths as a minimum and a maximum seems to me inappropriate in any case Taking the more general view of the wave-theory, the mistake to which I directed attention is due to the neglect of the Jacobi test[1] for the existence of maxima and minima The need for this test can be formally shown by considering the lengths AP and PR of Fig 2, which, as Mr Darbyshire mentions, are the minimum paths from P to A and R The statement that the path APR is a maximum then takes the form

$$\text{minimum} + \text{minimum} = \text{maximum},$$

which is obviously false

T. SMITH

[1] Forsyth, "Calculus of Variation", pp 26, 134, etc

Points from Foregoing Letters

RADIOPOTASSIUM (atomic mass 42) has been made from potassium atoms of mass 41 and from scandium atoms of mass 45 by bombarding them with neutrons It has now been obtained by Prof G Hevesy and Miss Hilde Levi, in the same manner, from calcium atoms of mass 42 These investigators have also prepared radioactive isotopes of calcium, zirconium and hafnium from the corresponding elements

Prof. H. Alfvén and Mr. V. H Sanner have obtained ultra-violet light of very short wave-lengths (down to 21A, on the borderland of X-rays) from a spark discharge between graphite electrodes

The relation between the intensity of the field applied and the magnetic induction produced in lead-thallium and lead-bismuth alloys at very low temperatures (when their electrical resistance approaches zero) is described by Messrs. J N. Rjabinin and L. W. Shubnikow. They show that above a certain field strength the alloys lose their 'supraconductivity'.

Contrary to theoretical expectations, the duration of luminescence of fluoresceine in water and in alcohol was found to be greater than in glycerine. Dr. A Jabłoński and Mr. W. Szymanowski consider that this unexpected behaviour can be explained by the rotation of the molecules

Mr. J. E. Carruthers and Dr. R. G. W. Norrish report that the presence of a small amount of formic or acetic acid quickens the condensation of gaseous formaldehyde to its solid polymer (known commercially as 'meta') They act in a similar way upon acetaldehyde vapour

Mr. S. M. Neale finds that the addition of salt to oxicellulose liberates its acidic hydrogen ion. The action can be made use of in the quantitative estimation of the acidity of oxycellulose.

The anomodont or dicynodont reptiles differ from all the other mammal-like reptiles, in having no teeth in the premaxillary bones The discovery of a fossil type which has teeth in the premaxillaries is reported by Prof R Broom It helps to bridge the gap between the several known families of reptiles.

Mr. S D. Rossouw finds a close proportionality between the percentage of cystine and of protein in grass in South Africa throughout the year The sulphur compound, cystine, is a constituent of sheep's wool.

Messrs F T Farmer and J A Ratcliffe have determined the average frequency of collisions between electrons and molecules in the F_2 region of the ionosphere (about 300 km high) Their experiments were carried out at times of the day when the absorption of the reflected waves by the E region (about 100 km high) does not change with time, a precaution which, they state, Mr Eckersley did not take when he measured the collisional frequency of electrons in the F_1 region (about 200 km high).

Working with dialysed muscle extracts, Dr D M Needham and Mr W E van Heyningen confirm the findings of Prof Parnas and his co-workers that adenylic acid and creatine are essential intermediaries in the reaction by which the muscle obtains its energy from the transformation of glycogen into lactic acid

Mr O. Darbyshire criticises the illustrations given by Mr T Smith, who has claimed that Fermat's principle requires an optical path to be stationary only, and not necessarily a maximum or a minimum Mr. T. Smith, in replying, justifies his consideration of non-linear optical paths in his variational treatment, by reference to the extended Huygens' principle.

Research Items

Archæological Studies of Disease Introduction. The archæologist has always to press into his services the methods of other sciences, and Dr John H Provinse, assistant professor of archæology at the University of Arizona, according to a communication issued by Science Service of Washington, D C, is utilising recent botanical studies in an interesting manner to check data upon the occurrence of disease among American Indians in prehistoric times Dr A E Douglass, astronomer of the University of Arizona, has developed very thoroughly the use of annual rings to determine dates over a period running back through many centuries, the western American climate having led to the formation, over wide regions, of growth rings that appear well correlated with varying climatic conditions Dr Provinse now attempts to match the growth rings in fragments of woods buried with diseased Indians with this well-established 'tree-ring calendar' The tree-ring calendar has enabled the age to be determined of many pueblos and cliff dwellings, and Dr Provinse now hopes to determine how far back various diseases that affect the skeleton can be traced Among the diseases diagnosed in these early Indians are Pott's disease, rickets, osteomalacia, a nutrition disorder of adult women resembling rickets, arthritis and Paget's disease The origin of syphilis is in the minds of the workers, but its diagnosis on pathological bone characters appears uncertain It is stated that so far there is no proof that it existed in America before the coming of Europeans

Cultural History of Cook Inlet, Alaska. Dr Frederica de Laguna's report on her expedition to Cook Inlet (University of Pennsylvania Museum, Philadelphia, 1934) covers the material collected during three seasons (1930–32) spent in Cook Inlet and Prince William Sound The main objective of the expedition was to investigate the question whether an earlier population with an Eskimo culture had preceded the present Athabascan Indians. The evidence considered here is based mainly, though not exclusively, on material from Kachemak Bay The Kachemak culture is interpreted as falling into four stages The basis seems to have been a fairly generalised type of Eskimo culture which included a number of elements common to the Arctic and North Pacific areas The stone industry of the earlier times is characterised by the relatively greater importance of chipping, including even the chipping of slate. Later, polished slate grows in importance and chipped stone becomes less important In the second period notched stones appear in great abundance. In the bone industry, the importance of Thule Type 1 is to be noted in the First Period Pottery and copper are rare and are restricted to the last phase of the Third Period The Second and Third Periods alike have flexed burial with grave goods. The dismembered burial is peculiar to the Third Period Artificial eyes and clay masks are characteristic of the Third Period Scattered and broken human bones belong to all periods except the First The house of the Second Period is partially built of stone and whalebone, that of the Third Period is entirely of wood Both are semi-subterranean The Eskimo dog, fairly well represented in the First Period, declines in numbers throughout the development of the culture. The culture of the First Period has more points of resemblance to the Arctic Thule culture of Canada, while that of the Third Period, which is the best known in this investigation, shows development away from the more typical Eskimo pattern towards a more specialised local complex

Education of Exceptional Children. In Pamphlet No. 49 of a series on "Teachers' Problems with Exceptional Children", published by the U S A. Education Office, Miss Elisa Martens deals with the children who, though not up to the normal standard of intelligence, are yet able to profit by training at an ordinary school Here they grow up in a normal environment, and can be trained for useful citizenship It is essential that the teacher should be interested in these children, and should study each case individually The curriculum should be modified for them if necessary, and their physical fitness promoted by care and by training in health habits, but above all they must be made happy, and this can best be done by giving opportunities for the expression of such talents as they possess in creative activity. Mentally retarded children need the same basic types of educational activities as do normal children, but the teaching should be as practical as possible The pamphlet gives much practical advice on a subject which must concern all those who are in any way responsible for the young

Preventive Inoculation against Diphtheria. In the spring issue of the *Fight against Disease* (**23**, No 1), the journal of the Research Defence Society, Sir Leonard Rogers contributes an article on the effect of preventive inoculation on the incidence and severity of diphtheria in nurses and children. He concludes from an analysis of a large mass of statistics that the Schick testing for susceptibility and the preventive inoculation are quite harmless, and no serious or harmful effect, still less a fatality, has resulted among 150,000 individuals treated Of 15,478 'protected' children, only 0 1 per cent were attacked, but no less than 22 5 per cent of 258 'unprotected' contracted the disease Similarly, of 5,579 'protected' nurses treating diphtheria cases and exposed to grave danger of infection, only 1·86 per cent were attacked, but of 166 known 'unprotected' nurses, no less than 24·1 per cent contracted diphtheria The average severity of the disease among inoculated persons attacked is also much less than among the uninoculated

Indo-Australian Fishes. Dr J D. F Hardenberg has discussed the species of the genus *Stolephorus* in *Treubia*, **14**, Livraison 3, 1934, and in the same journal he has two further papers on new or rare fishes of the Indo-Australian Archipelago and the fish fauna of the Rokan Mouth. *Stolephorus* is a genus the members of which are caught in coastal and estuarine waters Breeding along the coasts, their eggs are rarely found out at sea, but the adults may live in the deeper open sea waters, and there is evidence of migration not fully understood Many of them are good for food, the well-known red or Macassar fishes being coloured artificially with a fungus added during preparation. The author has discovered several new forms which he has studied in great detail—nine species in all. He suggests from the results of these investigations, and in accordance with the embryological data found by Dr. Delsman, that the long slender forms of the open sea with a high total number of vertebræ and the anus having a backward position are more primitive than the higher coastal forms with fewer vertebræ and the anus farther forward. In agreement with this, he states that it might be concluded that there had been during the evolution of the genus a migration from the open sea towards the coast and into the tidal rivers.

Migrations of Mule Deer. The summer range of the Rocky Mountain mule deer, *Odocoileus hemionus*, lies along the higher ridges at elevations of 4,000–12,000 ft., but in winter it descends, as a rule, to the lower foothills, from 3,500 ft. near the lower limit of the yellow pine forest to 1,500 ft. in the oak covered sides of the interior valley of California (Joseph S. Dixon in *California Fish and Game*, **20**, 1934, now published separately). Various factors contribute to this migration, the autumn and spring journeys of which may together cover one hundred miles. Food is an important item: if suitable food is available, some or all the deer may not migrate, and food considerations seem to outweigh the effect of low temperature. But a heavy fall of snow, by making food plants inaccessible, becomes a main factor in determining the autumn migration from the high ground. It also compels the deer to move to open hill sides where they can move freely, and this may enable them to obtain a livelihood on a winter range where forage is relatively sparse; but, most important of all, it adds to their chances of escaping from their enemies, the coyote and the cougar. The deer appear to realise that they are at a disadvantage against these carnivores in deep crusted snow, and although in some such areas food, in the form of wind-broken branches, remained abundant, they were avoided by the deer.

Larval Trematodes in Terrestrial Molluscs. W. Adam and E. Leloup have brought together (*Mem. Mus. Roy. d'Hist. Nat. Belgique*, No. 62, 1934) the records in the literature on the larval trematodes found in terrestrial molluscs, and have added critical and explanatory observations on them. They point out that the trematodes belong for the most part to the subfamily Brachylaiminæ (= Harmostominæ), and that the determination of the larval stages is almost impossible because of defective descriptions. The authors summarise in tabular form the measurements and other data available on the adults of the species of *Brachylaima* the larvæ of which are found in terrestrial molluscs, add a similar table for the larvæ, and a third table showing the trematodes recorded in terrestrial molluscs (except the Succineidæ). They record their observations on two species of *Brachylaima* from five helicine snails collected in Belgium.

The Embryonic Cell. The modern fashion for sectional monographs leads occasionally to the delimitation of subjects for treatment which leave the writer revolving almost *in vacuo*, and this seemed to have happened to Dr. René Souèges in the monograph on "La Cellule Embryonnaire" published as No. 208 of Actualités Scientifiques et Industrielles (Paris: Hermann et Cie). He expressly disclaims any intention of dealing with the phenomena of fertilisation or of subsequent embryonic development, and there remains very little to say in these 60–70 pages upon the plant oospore. It is probably very useful to have our ignorance of this all-important cell thus clearly exposed, and such problems as its polarity of organisation, the persistence of such structures as plastids, vacuome and chondriome are discussed very interestingly. Dr. Souèges goes a little beyond his own prescribed limits when he makes the interesting point that cell divisions follow most rapidly in Angiosperm oospores when these are associated with an endosperm also built of cells; when the endosperm remains for a long time a tissue with many nuclei without separate walls, then the oospore is slower to continue its development.

'Brown Spot' Disease of Turf. A short article by Dr. F. T. Bennett, in the *Gardeners' Chronicle* of February 23, describes a disease of grass turf known as dollarspot in America. It has been assumed that *Rhizoctonia solani*, the fungus causing *Rhizoctonia* disease of potatoes, was a common cause of brown spot maladies of turf. Dr. Bennett shows, however, that this is rarely the case in England, where another species of *Rhizoctonia*, named provisionally *R. Monteithianum*, is responsible for most of the damage. No spores of the fungus have yet been discovered, but it propagates itself readily from pieces of mycelium and sclerotial flakes. These may be blown by wind, and can withstand storage for fifteen months or more. Cultural characters of the fungus on artificial media, and symptoms of the disease on lawn turf, are described.

Gaseous Transfer of Silica. In *Economic Geology* (pp. 454–470; 1934), E. Ingerson discussed in a most stimulating way the problem of the possibility of transfer of 'insoluble' oxides by solution in gases at supercritical temperatures. That the process is a real one, and of fundamental importance in the genesis of both ore deposits and igneous rocks, is indicated by some experimental results recorded by F. V. Syromyatnikov (*Econ. Geol.*, pp. 89–92, 1935). The object of the study was the synthesis of serpentine from magnesium hydroxide (in the upper part of an autoclave) and silica and water (in the lower part of the autoclave). Silica was transferred upwards by water (gas) at temperatures of the order 400° C., and in some of the experiments Fe_2O_3 was also found to have migrated upwards. A sample of gas with 'dissolved' SiO_2 and Fe_2O_3 was condensed and analysed. The amounts found were 0·74 gm. of SiO_2 and 0·90 gm. of Fe_2O_3 per 1,000 gm. of water. Another point of interest is the proof that more silica was carried up, and fixed as serpentine, than was present at any given time in the gaseous solution. Hence diffusion of silica through the gaseous medium must have occurred.

New Zealand Pastoral Industries. A monograph on the pastoral industries of New Zealand by Dr. R. O. Buchanan is the first publication of the newly established Institute of British Geographers, which appears along with the *Transactions* as Publications Nos. 1 and 2. The treatment of the subject is mainly economic, and goes at length into questions of labour, marketing and prices; but certain facts of geographical importance emerge. The whole of the occupied area of the country seems to be suited for both cattle and sheep, but almost everywhere there is a more or less pronounced bias, in which local geographical conditions play a part, in favour of one or other branch of the live-stock industry. Conditions favouring cattle, which means dairy cattle since the world situation does not favour beef export, are low elevation, easy relief, rich soil and frequent, dependable rainfall. Absence of these factors, especially the topographical ones, leads to predominance of sheep. The monograph is well illustrated by maps and statistics, and is furnished with a detailed bibliography.

Ignition of Firedamp in Coal Mines. We have received papers Nos. 89 and 90 from the Safety in Mines Research Board, the former headed "The Ignition of Firedamp by Broken Electric Lamp Bulbs" by G. Allsop and R. V. Wheeler, and the second headed "The Ignition of Firedamp by Coal-Mining Explosives" by C. A. Naylor, W. Payman and R. V. Wheeler. The former is somewhat inconclusive. It is pointed out that under certain conditions the heated filament of an electric lamp after fracture of the glass bulb can ignite firedamp, and experiments have been carried out by the Research Board to see whether it is possible from the appearance of a tungsten filament to determine whether or not the filament has been burnt out in the presence of air (possibly air and firedamp mixed) and may therefore have originated an explosion. Whilst the condition of the filament, whether oxidised or not, can be determined, the results are by no means conclusive. The second paper gives a historical review of experiments on the Continent on the use of cooling salts for preventing explosives from igniting firedamp. It seems that an explosive sheathed in sodium bicarbonate is effective and practicable in this respect, and that the sheath does not interfere with the action of the explosive.

Insulators of High-Voltage Transmission Lines. It is now well known that when the insulators of high-tension lines are subjected to an atmosphere loaded with industrial or saline matter, the deposits they receive frequently cause 'faults' on the line owing to 'flashovers' at the normal pressure. In a paper read to the Institution of Electrical Engineers on March 20 by W. J. John and F. M. Sayers, it is stated that these flashovers are usually due either to the insulators getting coated with dirt or grit if near an industrial neighbourhood or, if near the sea, to a coating of salt. To prevent faults forming, it is necessary to keep the insulators clean, as the deposit may increase rapidly. In some cases an ounce of matter has been collected from an insulator after only a few weeks service. When it is an industrial deposit, experience has shown that all faults occur during fog and mist, and that all insulators which fail are covered with a deposit of carbon. It has also been noticed that no faults occur during or after rainfall. Normal rainfall keeps the insulators reasonably clean. This shows that the insulation can be improved by designing the insulator so that a large length of the leakage path is exposed to direct rainfall. Although rain can wash deposits away, it unfortunately provides a wet surface which forms by itself a leakage path. Similarly wind blows the deposits away, but it also brings grit and dust to them. Hence the good and bad effects of wind and rain have both to be taken into account when designing insulators. Salt spray is deposited when near the sea in moist sticky patches on their surfaces. When dew falls a conducting film of salt moisture is formed which may lead to sparking giving excessive leakage current and so cause the protective gear to operate and interrupt the supply. An important conclusion the authors arrive at is that insulators of different designs may be advisable along different sections of the transmission line.

Cataphoretic Velocity of Colloid Particles. Measurements of the cataphoretic velocity of colloid particles made by Messrs. G. N. Mukherjee and S. G. Chandhury, University College of Science and Technology, Calcutta, since 1923 and published in the *Journal of the Indian Chemical Society* from time to time, have indicated that the concept of the 'critical coagulation potential' is of doubtful value, since the value of the cataphoretic velocity at which coagulation occurs may vary very considerably according to the electrolytes employed. Furthermore, coagulation may occur when the velocity is greater than that of the original sol. The forms of the curves relating the cataphoretic velocity to the electrolyte concentration show no correlation for various electrolytes of differing valencies, whilst the velocity may often increase at high concentrations of univalent coagulating ions, especially near the stage of rapid coagulation. Some experiments with arsenious sulphide sols, made by Mr. K. D. Bhaback, have shown that on adding electrolytes, the cataphoretic velocity increases with time as aggregation proceeds, and falls sharply on coagulation. This increase of cataphoretic velocity with aggregation confirms the experimental conclusions of Robinson (*Proc. Roy. Soc.*, A, **143**, 130, 1934) who observed a similar effect in the case of particles of benzopurpurin B.

Alchemy at the Time of Dante. In a recent issue (pp. 411–417, 1934) of the *Annales Guébhard-Séverine* (Institut Guébhard-Séverine, 4 rue du Seyon, Neuchâtel. Issued free), Prof. J. Ruska gives a brief survey of Latin alchemy of the first third of the fourteenth century. It is to this period that he would ascribe the composition of the celebrated "Summa Perfectionis Magisterii", a work which he says has nothing in common with the genuine books of the Arabic Geber. A treatise of the same period, but one which in argument and exposition is in marked contrast to the "Summa", is the "Margarita Pretiosa Novella" or "New Pearl of Great Price" of Petrus Bonus of Ferrara. This is an introduction to alchemy, and was completed at Pola in 1330. Although the author apparently had some knowledge of practical chemistry and metallurgy, the book as a whole is an uncritical justification of alchemy on philosophical and metaphysical grounds. Its value to the historian of chemistry lies in the numerous and interminable quotations from previous authorities, which render it a rich mine of discovery in the detailed study of the influence of the older alchemists. The principal authorities are the pseudo-Rhazes, the "Turba Philosophorum" and the "Summa"; the paradox of the equal esteem accorded to the last two is explained by the fact that Petrus Bonus appreciated the value of the "Summa" but wished also to appeal to the venerable authority of the "Turba". As usual, the book concludes with a solemn assurance that it contains nothing but the pure truth. Prof. Ruska points out in his closing paragraph that the fourteenth and fifteenth centuries now form the most obscure period in the history of chemistry, and hopes that the problems they present may attract the young generation of chemists.

X-Ray Single Crystal Photographs of Insulin

By DOROTHY CROWFOOT, Department of Mineralogy, Oxford

SINCE insulin was first prepared crystalline[1] in 1926, several efforts have been made to obtain X-ray photographs of the crystals. The first attempts of W. H. George[2] by the powder method failed to show any pattern indicative of a crystal structure, and though later long spacings were reported by G. L. Clark and K. E. Korrigan[3], it was impossible to base any unambiguous interpretation on their results. The fact that pepsin could be made to give a single crystal X-ray diffraction pattern[4] suggested that the problem of insulin, which is in many respects a more stable crystalline species, could be attacked in the same way if large enough crystals could be grown. This was made possible by D. A. Scott's study of the crystallisation of insulin in the presence of salts of zinc and of other metals[5].

The crystallisation was therefore carried out by a modification of Scott's method from a phosphate buffer solution containing a little acetone and some zinc chloride at a pH of 6·2–6·5. The solution was cooled very slowly from 50° to room temperature over a period of three days, at the end of which time sufficiently large crystals had grown.

The crystals have the form of very flat rhombohedra which often grow in pairs united at the ends of their trigonal axes. The larger ones present the appearance of six lobed stars and are as much as 0·2 mm. across and 0·05 mm thick. These show a positive uniaxial figure when viewed along the trigonal axis. The crystals prove to be perfectly stable in air (unlike pepsin) with unchanged birefringence and reflecting power, and it was accordingly possible to examine them dry by X-ray methods.

Three series of X-ray photographs have been taken on three separate crystals, one rotating about the trigonal axis and the others about the normals to $(10\bar{1}0)$ and $(11\bar{2}0)$. Examples are shown in Fig. 1. Copper $K\alpha$-radiation was used and exposure times of about 15 hours for a single 5° oscillation photograph with a plate distance of 6 cm. The crystals have so far proved unaltered by exposure for more than 100 hours to X-radiation. The photographs taken indicate a simple rhombohedral cell of a 44·3 A. and $\alpha = 115°$ correct to about 2 per cent. This referred to hexagonal axes corresponds to a cell three times as large with $a = 74{\cdot}7$ A., $c = 30{\cdot}6$ A., which shows no halvings but those required by the rhombohedral lattice. The structure may also be described in terms of a pseudocubic body-centred cell twice the size of the primitive cell with $a = 47{\cdot}7$ A., $\alpha = 103°\ 6'$. No planes of symmetry are present and the space group is therefore $R3$. The cell molecular weight calculated for the primitive rhombohedral cell and the density 1·315 measured by Dr. Eyer[6] is 39,300 ± 800. (Density measurements on the actual crystals used gave $1{\cdot}306 \pm 0{\cdot}003$.) As Abel has measured the water lost by heating the crystals at 104° in a vacuum at 5·35 per cent of the air-dried weight[7], the weight of insulin in the cell (cell molecular weight—water of crystallisation) may be deduced as 37,200, which is very close to the weight of one molecule of insulin reported by The Svedberg[8].

It therefore appears that the crystal unit cell contains only one molecule of insulin, although a cell containing $3n$ sub-molecules is not excluded by the X-ray data. The laws of crystal symmetry rigorously applied would require this molecule to have trigonal symmetry, but it is possible also that the crystal attains apparent trigonal symmetry by a statistical regularity of arrangement of molecules about the lattice points, or that the X-ray effects so far observed are first approximation mass effects to which further work may add a fine structure, due to the arrangement of the atoms within the molecules, which our methods are as yet insufficiently delicate to detect. The measurements obtained do, however, fix quite definitely the arrangement of the molecules with respect to one another and their approximate size and shape, since this follows directly from the crystal lattice, while the variation of the intensities of the spectra strongly suggests that the arrangement of atoms within the molecules is also of a perfectly definite kind.

The crystal structure of insulin is of an eight co-ordination type, as the possible reference to the pseudo-cubic body-centred cell of twice the size most clearly indicates. Each insulin molecule is surrounded by eight others, two at the short distance of 30 A. above and below along the trigonal axis, and six at the longer distance of 44 A. along the edges of the primitive rhombohedron. The shape of the molecule therefore appears approximately as an oblate spheroid of diameters 44 A. and 30 A. D. A. Scott gives the atomic percentage of zinc in insulin crystals as 0·00795, or 3 atoms of zinc per molecule of insulin[9]. It therefore seems reasonable to suggest that these atoms are required to bind the molecules into nets parallel to the c plane, one between each pair of insulin molecules along the six points of contact, the closer linkage along the c axes being due to other causes. This would provide some explanation of the rôle played by zinc and other bivalent metals in promoting the crystallisation of insulin.

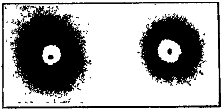
(a) (b)

FIG. 1. X-ray photographs of crystalline insulin. (a) Rotation axis normal to $(11\bar{2}0)$, beam direction 0°–5° from ‖ $(10\bar{1}0)$. (b) Rotation axis [0001], beam direction 0°–5° from ‖ $(10\bar{1}0)$.

It is of particular interest to compare this crystal structure of insulin with that which may be deduced for pepsin from the X-ray measurements previously reported. It has been found that the true cell of pepsin has a c dimension three times as long as that at first suggested, namely, 461 A., and that the structure should probably be referred to rhombohedral axes[10] $a = 162$ A., $\alpha = 23°\ 50'$. The first order of the reflections from the c plane to occur is, however, the 45th, while the strongest order is the 48th, which indicates that the most marked periodicity along c is one of only 9·6–10·2 A., very much the same as the distance—10 A —between layers of atoms along the *c* axis of insulin It seems significant, further, that the length of *a* in pepsin—67 A —referred to the original hexagonal axes, is so similar to that of insulin—74 7 A. --when given hexagonal axes These two dimensions define a crumpled layer structure in which the molecules are arranged in networks of six sided rings of the non-planar cyclohexane type which occurs, for example, in diamond and wurtzite From the side of such a ring projected on to (0001), $a/\sqrt{3}$, or 38 7 A in pepsin, and the thickness of the order of 10 A , a length for one radius of the pepsin molecule may be calculated ≃ 20 A In insulin, the layers are so arranged that atoms in one fall as nearly as possible into the spaces of the one below, which makes a very compact structure In pepsin we may imagine that the layers of rings are slid relatively to one another, to bring atoms of the lower ring directly beneath those of the upper ring in such a way that each is approximately tetrahedrally co ordinated The effective depth of a single layer is then equal to the thickness of the ring system plus the diameter of a single molecule, and may be calculated to be 51 2 A , with a spheroidal pepsin molecule of diameter 41 2 A in this direction A combination of the crystallographically possible ways of sliding the ring systems is able to give the required length of *c*, nine times that of the depth of one layer and fifteen times the *c* dimension of insulin

This kind of structure proposed for pepsin is of a very much looser type than that of insulin Each molecule is surrounded by only four others and there are large channels through which free movement of water and dissolved substances may occur within the crystal structure On drying, such a structure would collapse, in agreement with the fact that, in contradistinction to insulin, the crystals of pepsin lose their birefringence on exposure to air and only show crystalline X-ray diffraction effects when immersed in the mother liquor Various observations[11] suggest that loose 4 co-ordination structure of this kind may be general among certain classes of protein crystals which belong either to a hexagonal type with an axial ratio about 2 3 similar to that of pepsin, or to a cubic type which shows diamond cleavages. Wherever the attraction between the adjacent protein molecules is of the same order of magnitude as that between the protein molecules and the medium, a low co ordination structure type may be expected. In insulin, on the other hand, where the molecules can be strongly attracted together with the assistance of metal atoms, the structure is very much more condensed and shows a high co-ordination number

I have to thank Prof Pyman and Messrs. Boots Pure Drug Co , Ltd , for a gift of the insulin used in this research

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History of the Menthols

AT a joint meeting of the Chemical Society, and the Glasgow Sections of the Society of Chemical Industry and the Institute of Chemistry, held in the Royal Technical College, Glasgow, on March 15, Prof. John Read, of the University of St Andrews, gave a lecture entitled "From Governor Phillip to *d*-neoisoMenthol: the Story of a Research, 1788–1934"

Prof. Read said that it was his intention to select a research paper and show what a rich background it possessed when given its proper setting in the world of things, men and affairs The paper in question closed a chapter, or perhaps more correctly a book, in the history of the important chemical family of menthols The usual source of ordinary menthol is the essential oil of the peppermint plant, *Mentha piperita*, which has been cultivated in Japan for more than two thousand years The first mention of crystalline menthol was made in 1771 by Gambius, a Dutch botanist It is now known that this so-called 'mint camphor' is a member of the first of four series of menthols Prof. Read and Dr. Grubb completed the tale of these four series in the University Chemical Laboratories at St Andrews on Christmas Day, 1933

In tracing the trend of events which led up to this chemical climax, Prof Read reminded his audience that Capt Cook landed in eastern Australia, hitherto unknown, on April 29, 1770 In his "Journal" he wrote of the landing-place : "The great quantity of New Plants, etc., Mr. Banks and Dr. Solander collected occasioned my giving it the name of Botany Bay" From the earliest days, indeed, the unique vegetation of this isolated land attracted the interested attention of visitors and settlers. Two-thirds of the native Australian flora belongs to the family Myrtaceæ, which is represented in Europe by a single species *Eucalyptus*, the outstanding Australian genus of this family, is a specialised form adapted to the barren and extra-tropical Australian areas , it developed after the separation of Australia from the tropical lands Typically Australian, it is virile, aggressive, and an excellent colonist, with all the characteristics of youth

Some graphic extracts from Dr John White's "Journal of a Voyage to New South Wales" followed. Dr White was surgeon-general to the First Settlement, under Governor Phillip, who reached Botany Bay with his fleet of marines, officials and convicts on January 20, 1788, after a voyage lasting eight months The "Journal" shows that the voyage had its romantic aspects as well as its hardships and notes of grimness . "May 28 Departed this life, Ismael Coleman, a convict, who, worn out by lowness of spirits and debility, brought on by long and close confinement, resigned his breath without a pang. August 31. James Baker, a private marine, received 200 lashes for endeavouring to get passed on shore by means of one of the seamen, a spurious dollar, knowing it to be so. . . Many of these young ladies [in a convent in Rio de Janiero] were very agreeable both in person and disposition ; and by frequently conversing with them at the grate, we formed as tender an intercourse as the bolts and bars between us would permit of."

The fleet lingered for a month at Rio, before weighing for the Cape of Good Hope. It is said, although Dr. White does not endorse the statement, that Governor Phillip took with him from Brazil some prickly pear plants, for the sake of the cochineal insects which infested them. These insects produced the scarlet dye used for the military uniforms of those days. Unfortunately, the insects appear to have perished during the voyage; thus the prickly pear, freed from its insect control, developed eventually into Australia's foremost plant pest.

At that time, oil of peppermint was a much prized specific; for in the first issue of the *Glasgow Advertiser*, dated January 27, 1783, it is stated in an advertisement that "this elegant preparation", sold by J. Gillies, bookseller, above the Cross, Glasgow, gives immediate relief "in Gouty and Cholicky Pains in the Stomach and Bowels, Low Headachs, and all Disorders arising from wind". Dr. White, being short of this oil, found a very efficient substitute in the essential oil distilled from a certain eucalypt growing around Port Jackson—now known as the Sydney peppermint, or *Eucalyptus piperita*. This is the first recorded instance of the distillation of a eucalyptus oil.

Many years later, in 1900, the Australian chemist, H. G. Smith, isolated the peppermint ketone imparting the characteristic odour to this oil, and called it piperitone. There are about three hundred species of eucalyptus, each kind—as shown by H. G. Smith and R. T. Baker—producing its own characteristic leaf oil: of these more than twenty secrete piperitone. It was then found that, by hydrogenation and dehydrogenation, piperitone could be changed into menthols and thymol, respectively, so that it has become a commercially valuable substance.

Eucalyptus piperitone is invariably a 'left-handed' substance. Soon after Prof. Read became associated with Mr. Smith at Sydney, in 1920, Prof. J. L. Simonsen, working independently at Dehra Dun, in India, discovered 'right-handed' piperitone in the oil of the Indian grass, *Andropogon Jwarancusa*. These two piperitones, of the northern and southern hemispheres, are identical, except that their molecules are related as object and mirror images.

One interesting result of later researches, carried out at St. Andrews, has led to a way of proceeding, by laboratory processes, from the 'left-handed' Australian piperitone to the 'right-handed' Indian piperitone. It has also been found possible by means of a complicated network of delicate reactions to utilise piperitone as a source of any one of the four series of menthols. Each of the four kinds of menthol exists in a 'right'- and 'left'-handed form, and methods have been devised for producing the 'right-handed' form of ordinary 'mint camphor', which always is 'left-handed' in Nature.

Crossing-Over of Sex Factors in *Lebistes*

WHILE the validity of the sex-chromosome mechanism in relation to sex determination is generally recognised, yet it has become clear from the work of Goldschmidt on *Lymantria*, Winge on *Lebistes*, and various other investigations in which intersexes and the crossing-over of sex factors occur, that genes influencing the sex towards maleness or femaleness are also found in the autosomes. Bridges' conception of genic balance applies to many characters, including sex, and it is necessary to suppose that there are many factors in all the chromosomes, some of which tend towards maleness and others towards the female condition. Various divergent views regarding the distribution of such genes in the X and Y and the autosomes are at present held.

In the little fish, *Lebistes*, in which there is a series of colour patterns inherited through the Y chromosome from father to son, Winge has shown also that the X chromosomes may be altered into autosomes, so that sex linked genes are inherited as ordinary Mendelian differences. By selecting masculine autosomal genes, XX males were obtained, and by back-crossing a race was produced in which both the males and females were XX in composition and the Y chromosome type of inheritance had been eliminated.

In a recent paper (*C. R. Lab. Carlsberg*, Série Physiol., 21, No. 1) Winge has carried the subject of sexual balance further. Probably in these fishes, as in pigeons, the difference between the sexes is small, so that the balance of the sex genes is easily upset. This is further shown by the fact that certain matings gave practically only females in winter but equal numbers of the sexes in spring. Nevertheless, conspicuous intersexes seldom appeared. Normally, females show no trace of the colour genes which are transmitted by the males in the Y-chromosome, but occasional females appear which show a trace of the male pattern and probably have several masculine genes. In a cross involving the *maculatus* and *lineatus* races, 7 XY females appeared having the *maculatus* spot. Crossed with XY males they gave, as predicated, 3 males : 1 female. Among these were fertile YY males which, when crossed with normal females, gave only male offspring.

There are no unequal pairs of chromosomes in *Lebistes*, so the X and Y must be of equal size. Among other conclusions reached are that all the genes in X are able to cross over to Y, and that the Y contains at one end a specific male-determining gene which is at the same time a gene for colour pattern. The X lacks this gene, but whether it possesses an allelomorphic feminine gene is undecided.

R. R. G.

University and Educational Intelligence

ABERDEEN.—The honorary degree of LL.D. has been conferred on the following, among others: Prof. E. V. Appleton, Wheatstone professor of physics, King's College, London; Mr. W. H. Buckler, engaged in archæological work in Asia Minor; Lieut.-Col. A. T. Gage, formerly director of the Botanical Survey of India and superintendent of the Royal Botanic Gardens, Calcutta; Dr. J. C. G. Ledingham, professor of bacteriology, University of London, and director of the Lister Institute, London.

EDINBURGH.—A gift of £10,000 has been received from Mr. J. Albert Thomson for the purpose of establishing a commercial laboratory in the University. This will provide for the immediate requirements in staff and equipment for a laboratory providing the approved methods of training for students for the commerce degree, so that those who aspire to the higher positions in industry shall have an intimate working knowledge of all up-to-date office machinery and appliances.

LONDON.—The County Borough Council of West Ham has decided to make a grant of £2,500, payable over five years, towards the cost of the erection of the new buildings in Bloomsbury. The Worshipful Company of Plumbers has made a donation towards the cost of the Ceremonial Hall to be built on the Bloomsbury site.

ST ANDREWS.—The University Court has recorded a Minute on the occasion of the jubilee of the appointment of Prof. D'Arcy W. Thompson to the University (NATURE, 135, 59, Jan. 12, 1935). Tribute is paid to his outstanding worth and ability, not only in his own department of natural history but also in other departments of literary and scientific knowledge. His election to the presidency of the Classical Association testified to his knowledge of and interest in the ancient languages and literatures of Greece and Rome; his election as an honorary member and as president of the Edinburgh Mathematical Society in recognition of his pioneer work in the application of mathematical methods to biological studies was a guarantee of mathematical ability of no mean order; and his work as adviser to the Fishery Board for Scotland, and as a delegate to the Bering Sea Fisheries Conference and to the North Sea Conference indicated his international reputation as a scientific administrator.

MOSCOW STATE UNIVERSITY will hold a summer school from July 16 until August 25. Instruction will be in the English language by an all-Soviet staff in twelve courses of thirty hours each, with occasional addresses by prominent Soviet officials. The subjects of the courses include: Russian language (advanced), Russian literature, Russian arts, Russian education, Russian technology, Russian economics, Russian geography and Russian history (of the Soviet Union), administration of justice, public health and medicine, and the philosophy of dialectical materialism. The students will also be able to choose one of six specially organised tours. Last year's summer school enrolled 212 students.

UNIVERSITY COLLEGE, London, continues to attract students from abroad in large numbers. The recently issued annual report shows that of a total of 3,231 students enrolled in 1933–34, no fewer than 744, or 23 per cent, were from countries outside the British Isles, namely, 304 from other parts of the Empire and 440 from some forty foreign countries. Among European countries Germany contributed 102, France 35, Switzerland 26 and Holland 19 students, while India was represented by 157, the United States of America by 45, South Africa by 31, Palestine and Australia each by 26. In the course of the year, the quinquennial visitation by members of the University Grants Committee took place, and from the summary of developments of the years 1930–35 prepared for presentation to the Commissioners, a number of interesting paragraphs have been reproduced in the report. One of these, relates to the great change that has taken place in the proportion between full-time and part-time students, the former having increased almost continuously since 1925–26 while the latter have diminished from nearly 1,600 to less than 1,100. The number of full-time postgraduate and research students has risen during the past ten years from 168 to 255. Several departments of the College were enabled, through the generosity of various benefactors, to offer hospitality during the past year to a number of scholars exiled from their homes in Germany, among them the distinguished chemist Prof. H. Freundlich. Annexed to the report is an address by Sir Josiah Stamp, delivered by him as Special Visitor on the occasion of the annual assembly of the Faculties: the subject is "The Management of Mind".

Science News a Century Ago

Lyell and Mantell

On April 13, 1835, Lyell wrote to Mantell: "I have been getting Dinkel to figure for me some fossil eggs of a turtle, found in the island of Ascension, imbedded in a hard rock something like that of Guadaloupe which contains the human skeleton. It is clear that the eggs were nearly hatched at the time when they perished for the bones of the young turtle are seen in the interior with their shape fully developed. . . . On my showing the specimen containing seven eggs to Owen, of the College of Surgeons, he remarked to me that they were hollow, whereas the bones of reptiles want the medullary cavity. Struck with this remark, and with the extreme hollowness of the bones, only to be compared to that of some Tilgate specimens which you have often shown me, I got Owen this morning to dissect for me a young turtle, not a fœtus, but so young that the mark of the attachment of the yolk was still a large opening. He immediately showed me that the bones were not hollow, though we both remarked that the outside looked harder than the interior. Owen has promised to get me a set of very young turtle's bones from the Zoological Gardens, and I am persuaded it will clear up a number of your difficulties."

The Zoological Gardens

"The Commissioners of Woods and Forests," said *The Times* on April 14, 1835, "have recently granted to the members belonging to the Zoological Gardens, in the Regent's Park, an extensive increase of land consisting of 10 acres, on the south side of the Park, which is now railed in. Immediately an immense number of workmen of various denominations will be employed in levelling the ground, laying out, and planting elegant shrubberies; erecting superb habitations for various beasts and birds, which will be placed in them with all possible speed, from the society's collection at Kingston-on-Thames, where they have an immense farm. On the completion of the intended improvements, these gardens will present to the public the most superb promenades in England, the whole of which will be completed in a few weeks. Since the commencement of the warm weather, the whole of the beasts and birds which were of tender habits have been removed from the menagerie, where they have been kept during the winter months, and are now exhibited to the public. During the present spring, these gardens will be considerably more frequented, on account of the immediate opening of the Regent's Park to the public. The grand broad gravel walk which passes through the Park leads to the Zoological Gardens."

The Franklin Institute

The forty-fifth quarterly meeting of the Franklin Institute, Philadelphia, was held on April 16, 1835. Various donations of books were stated to have been received, some of these being from the Society for the Encouragement of Arts, Manufactures and Commerce of London, and others from Faraday. In the report of the Board of Managers, it was said that "The Lectures of the Institute were closed on the 25th March last; the large number of the class, and the regular attendance during the season, clearly evince the interest taken by the members and the public in this method of popular instruction, which, the Board indulge the hope, will long continue. A large portion of the time of the Committee on Publications has been industriously devoted to the improvement of the Journal, and its high reputation, not only throughout our own country, but also in Europe, should in the opinion of the Board, induce the members of the Institute, and the public generally, more extensively to encourage and patronize it . " Referring to the exhibition arranged for October 1835, the Board said "To awaken and create a laudable spirit of emulation and improvement, has always been the principal object of the exhibition of articles of domestic manufacture, and the Board rely with great confidence upon the support and co-operation of the mechanics and manufacturers of Pennsylvania, and of the United States, to render the exhibition of this year as interesting, attractive, and useful as those of preceding years "

The German Universities

On April 18, 1835, *The Times* stated that ' the number of these institutions is 19, 2 only of which, those of Berlin and Bonn, were founded in the present century; there were 3 established in the 14th century, Heidelberg, Prague and Vienna , 6 in the next century, 2 in that which succeeded, and 3 each in the 17th and 18th centuries The earliest founded was of the Protestant religion, the last for both Protestants and Catholics Of the whole number there are 11 Protestant, 5 Catholic and three mixed The greatest number of professors is at Vienna, where there are 79 ; the least at Erlangen and Kiel, each having 29 The greatest attendance of students is at Vienna and Berlin—nearly 2,000 each , the least at Rostock, 110 , the number of professors at which are 34, very nearly one master to 3 students , and at Kiel, where there are 29 professors, and only 130 students. The universities next best attended by students to those named as having the greatest number are Prague, Leipsic, Breslau and Heidelberg, each of which has more than 1,000 students "

Societies and Academies

PARIS

Academy of Sciences, February 25 (*C R*., **200**, 701–792). **LOUIS LUMIÈRE** : Coloured screens for stereoscopic projections **CHARLES CAMICHEL and MAX TEISSIÉ-SOLIER** : The influence of a perturbation of an immersed body, under the Poiseuille condition **PAUL PASCAL and MARCEL PATRY** . Introduction to the study of the telluric acids Description of the effects on dehydration at increasing temperatures of orthotelluric acid. **ALEXANDRE MINIATOFF** A property of transformations in space of two complex variables. **GEORGES VALIRON** The number of transcendental singularities of the inverse functions of a class of algebroids. **PIERRE DIVE** : Coronas with constant *logarithmic potential and integral* relations characteristic of the ellipse. **BORIS FUCHS** · Limitations for the variation of an angle in the case of a pseudoconformal transformation in space of two complex variables. **PETER THULLEN** : The second problem of Cousin. **LOUIS FEYLER** : The course of the Tafassasset valley to the north of the Grand Erg of the Ténéré and the probability of its prolongation, to the south, up to Tchad. **J. TILHO** : Remarks on the preceding communication. **PAUL CHAMBADAL** : The refrigeration of water by fractional evaporation **RENÉ PLANIOL** Currents of positive ions produced in a high vacuum. **NY TSI ZE and TSIEN LING-CHAO** The laws of the evolution of electricity by torsion in quartz. Two formulæ have been suggested for the quantity of electricity evolved by torsion in quartz, one by the authors and another by E P Tawil For certain dimensions of hollow cylinders either formula represents the experimental facts fairly well, but with a wider range of ratio of internal and external diameters, the authors' formula appears preferable **IGNACE ZLOTOWSKI** The passage of the current at potentials below the decomposition potential of electrolytes **EMILE THELLIER** An induction apparatus for the measurement of small magnetic moments The apparatus described is designed to eliminate the errors due to the instability of the zero to variations in the external magnetic field and to thermo-electric effects in the circuit It is sufficiently sensitive to measure the magnetisation of rocks and baked clays. **BERNARD LYOT** A green monochromatic filter Combinations of neodymium glass, or a solution of neodymium nitrate, with Schott *VG* 3 glass One combination transmits a band at 82 A **PIERRE AUGER** The absorption of the cosmic radiation A discussion of the published work on this subject The hypothesis of a single type of primary cosmic rays does not give an explanation of the whole of the experimental facts. **JEAN GRÉVY** The viscosity of very dilute solutions of nitrocellulose in ether alcohol mixture According to Staudinger the specific viscosity of a colloidal solution is independent of the solvent The specific viscosities of very dilute solutions of nitrocellulose in mixtures of ether and alcohol are given, the proportion of alcohol varying from 18 to 90 per cent Between 20 and 90 per cent of alcohol, the specific viscosity is practically constant · with lower proportions of alcohol, the specific viscosity is lower **JAMES BASSET and MAURICE DODE** : The direct synthesis of nitrates at ultra-pressures. The amounts of nitrate obtained by heating baryta, baryta plus potash and lime with mixtures of nitrogen and oxygen at pressures of 3600 kgm are given for temperatures ranging from 500° C to 900° C **RENÉ PERROTTE** The synthesis of ricinic acid (12-ketostearic acid) **MARCEL GODCHOT, MAX MOUSSERON and ROBERT GRANGER** The dehalogenation of the cyclanic chlorhydrins with shortening of the ring. **MAURICE BADOCHE** Researches on the dissociable organic oxides The photo-oxidation of sodium 1, 1′, 3′ triphenylrubene carboxylate **GEORGES RICHARD** · Contribution to the study of the α-chlorketones. **ANTOINE WILLEMART** · Contribution to the study of the preparation of coloured hydrocarbons of the rubene type **ANDRÉ WAHL and MARC RINGEISSEN** · 2, 2′ Dihydroxy-1, 1′ dinaphthyl sulphide **GEORGES DUPONT and WITOLD ZACHAREWICZ** . The synthesis of nopinene and 1, 5.pinadiene starting with pinene. The oxidation of pinene by selenium dioxide yields the myrtenol already described, nopinene and 1, 5.pinadiene. ***CAMILLE LEFÈVRE and CHARLES DESGREZ*** Contribution to the study of the aromatic sulphides. The phenol mono- and di-sulphides previously described, as well as their complex mercury compounds, give well-defined stable salts **J. JUNG and M. ROQUES** : The petrography of the crystallophyllian strata of the Bas-Limousin **E CHAPUT** The Eocene of the plateau of Galatie (Central Anatolia) **P. LEJAY** : Study of the diurnal variation of atmospherics at Shanghai. Three years observations are summarised in monthly curves **Pierre Dangeard** · The structure of some quiescent nuclei **Albert Pitot** · The morphology of the seed of the Leguminosæ in its relations with systematics **Emile Saillard** and **Roger Saunier** The determination of the ash of sugar beets by measuring the electrical conductivity **P Portier** and **Mlle A Raffy** The action of water with low surface tension on the plumage of aquatic birds **Etienne Rabaud** and **Mlle Marie Louise Verrier** The swim bladder and the pneumatic canal Reply to criticisms of J Meisenhans **Emil Cionga** The presence of α pyrryl-methyl ketone in stabilised officinal valerian This ketone is regarded as one of the active principles of valerian **Emile Brumpt** Paludism in birds *Plasmodium gallinaceum* of the domestic fowl **Mlle Nine Choucroun** and **Maurice Peltier** The ultra virus of murine leprosy **G Mouriquand, J Rollet** and **M Courrières** The ultra violet test for A avitaminosis **Etienne Sergent** The action of subcutaneous injections of water against fatal doses of snake poison In experiments with mice, the specific serum saved 12 out of 30, a serum active against other snakes saved 10 out of 30, whilst physiological water saved 5 out of 30 **Alexandre Besredka** and **Ludwik Gross** Cuti vaccination of mice against sarcoma.

AMSTERDAM

Royal Academy of Sciences (*Proc*, 38, No 2) **Ernst Cohen** and **H L. Bredée** The velocity of oxidation of tin A gas-dilatometric study showed that tin oxidises in dry air at 18° C with a measurable velocity **E D Wiersma** Influence of the similarity and dissimilarity of mental qualities of the parents on their children (3) The children of happily and unhappily married parents were examined with regard to differences in temperament, intellect and tendencies **J. Funke** and **C F E Simons** The β-bands of boron monoxide An analysis of the $B^2\Sigma \rightarrow X^2\Sigma$ bands of BO **P. J. Bouma**. Outlines of a general theory of the colour metric. (2) Conclusion of a generalisation of Schrödinger's colour metric to allow for the part of the 'rods' of the retina in colour vision **F. Zernike** and **H. C Brinkman**. Hyperspherical functions and the polynomials orthogonal in spherical regions. **M. Pinl** Quasi-metric on totally isotropic surfaces. (3) **A Jeannet** On two irregular echinoderms from the lower chalk of Ibiza (Balearic Is.) **M G. Rutten** · *Orbitocyclina*, Vaughan, a synonym of *Lepidorbitoides Silvestri* The genus *Lepidorbitoides* is identical with *Orbitocyclina* and the latter name should disappear **G H R von Koenigswald**. The fossil mammalian fauna of Java Important conclusions regarding the original connexions of Java with the continent of Asia, the time and order of their severance are drawn **W. J. Prud'homme van Reine**. Plasmolysis and deplasmolysis The variation of plasmolysis and deplasmolysis of epidermal cells from *Allium cepa* in saccharose solutions has been investigated as a function of the temperature and concentration. **H J. Vonk**: Solution of fat and fatty acid by the gastric juice of *Potamobius leptodactylus*. The gastric juice is able to bring into solution particles of milk fat and oleic acid suspended in water. This result is discussed in connexion with the digestion of fats and fatty acids by invertebrates. **F. E. Kredel** and **W J. Roberts**. Supra-vital staining of cartilage A satisfactory method is described for differentiating living and dead cartilage cells with neutral-red as a supra-vital stain.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, April 14

British Museum (Natural History), at 3 and 4 30 — Capt. Guy Dollman (1) "Egg Laying and Pouched Mammals" (2) "African Antelopes".*

Monday, April 15

British Museum (Natural History), at 11 30 —F C Fraser "Stranded Whales on the British Coast" *

Royal Geographical Society, at 8 30 —V E Fuchs. "The Lake Rudolf Rift Valley Expedition"

Wednesday, April 17

Royal Microscopical Society, at 5 30 —Dr B H Knight "Modern Uses of the Petrological Microscope in Road and Building Problems".

Official Publications Received

GREAT BRITAIN AND IRELAND

Navy (Health) Statistical Report of the Health of the Navy for the Year 1933 Pp 152 (London H M Stationery Office) 2*s* 6*d* net

Wool Industries Research Association Report of the Council, 1934 Pp 39 (Leeds Wool Industries Research Association)

Researches published from the Wards and Laboratories of the London Hospital during 1934 Pp iv + 89 papers (London H K Lewis and Co, Ltd) 7*s* 6*d* net

Report of the Rugby School Natural History Society for the Year 1934 (Sixty-eighth Issue) Pp 56 (Rugby. George Over, Ltd)

Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending July 31st, 1934 Pp 65 + 7 plates (Newcastle-on-Tyne Armstrong College) 5*s*

City and County of Bristol Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 31st December 1934 Pp 28 + 4 plates (Bristol)

OTHER COUNTRIES

Technical Books of 1934 Compiled by William W Shirley (Twenty-seventh Issue) Pp 28 (Brooklyn, N Y Pratt Institute Free Library)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1934 Pp liv + 219 + 7 plates (Bern Paul Haupt.)

U S Department of Agriculture Technical Bulletin No. 481 · A Revisional Study of the Genus *Scolytus* Geoffroy (*Eccoptogaster* Herbst) in North America By W M Blackman Pp 31. 5 cents. Technical Bulletin No 460 Studies of *Exeristes roborator* (Fab), a Parasite of the European Corn Borer, in the Lake Erie Area By W. A Baker and L G Jones Pp 27 5 cents (Washington, D C Government Printing Office)

List and Prices of Publications issued by the Carnegie Museum Pp 84 Annals of the Carnegie Museum Vol 23, 1934 (Serial No 162.) Pp xii + 432 + 50 plates 3 50 dollars (Pittsburg, Pa Carnegie Museum)

Science Reports of the Tokyo Bunrika Daigaku, Section B No 28 Preliminary Note on the Pearl Organs in some Japanese Cyprinoid Fishes By Yaichirô Okada Pp 29–36 + plates 3–5 25 sen. No 29 Species of the Genus *Pinnixa* (Pinnotherid Crab) found in the Far East By Tune Sakai Pp 37–43 15 sen No 30 Note sur un nouveau trématode *Cephalogonimus japonicus*, parasite intestinal de la tortue comestible l'*Amyda japonica* Par Tôji Ogata Pp 45–53 15 sen. No 31 Beiträge zur Physiologie des Austerherzens, 5. Über den Bau des Herzens unter besonderer Berücksichtigung seiner physiologischen Reaktionen Von Shun-ichi Takatsuki Pp 55–62 15 sen (Tokyo Maruzen Co, Ltd)

Legislative Assembly New South Wales Report (together with Appendices) of the Minister of Public Instruction for the Year 1933 Pp 44 (Sydney Government Printer) 3*s*

The Oil Palm in Malaya By B Bunting, C D V Georgi and J N Milsum (Malayan Planting Manual, No 1) Pp xiii + 293 + 36 plates (Kuala Lumpur Department of Agriculture) 2 dollars

Forest Bulletin No 88 Seasonal Progress of Height Growth in Trees By H G Champion Pp iii + 14 + 5 plates (Delhi Manager of Publications) 14 annas, 1*s* 6*d*

Transactions of the Mining and Geological Institute of India Vol 29, Part 4 The Mineral Resources of Rajputana. By Dr A M Heron Pp 289–408 + xv + plates 8–11 (Calcutta. Mining and Geological Institute of India) Members and Associates, 2.8 rupees, non-Members, 4 rupees

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The Universities and Technical Training

PROF MAJOR GREENWOOD'S attempt to assess the functions of university education in the conditions of to-day in his stimulating presidential address on university education last November to the Royal Statistical Society, which has recently been published (*J Roy Stat Soc* , **98**, 1 , 1935), deserves more than passing attention There has been much criticism of the efficiency of university education from an industrial point of view, and what has been said about the evils of specialisation and the shortcomings of the graduate in some highly specialised branches of knowledge has scarcely been too strongly expressed It must be remembered, however, that the graduate is largely the product of a system, and in the average man his merits and demerits at this stage are less the outcome of personal idiosyncracy than the result of the system under which he has been trained

This indeed has been fully recognised in such recent discussions as those before the Glasgow Section of the Society of Chemical Industry on the "Education of the Industrial Chemist", or that following Dr Underwood's address on "The Chemical Engineer and his Training for Industry" before the Manchester Section of the same Society Both schools of thought to be found at the present time are opposed to excessive specialisation before entering industry The difference between them lies rather in that one school would confer the technical knowledge and training after entering industry, while the other wishes to carry university or technical training to a point at which the graduate is almost immediately of direct service to industry

The existence of such divergent opinions is a matter of some embarrassment to those responsible for educational policy at the present time, particularly that of the technical colleges Generally speaking, it is only the large companies or combines that can afford to devote the first six months or year after a graduate enters their service to definite training courses calculated to give him a grasp of the industry and to test his qualities and particular gifts The smaller firms require men who can offer an immediate return, if only in the fulfilment of routine duties while gaining a modicum of experience. To them it is highly important that the graduate should have had some broad training in the particular branch of technology underlying their industry.

The comparative indifference of the larger firms to training in technology when selecting staff cannot but have a considerable effect upon the training given in the technical colleges, particularly in the full-time courses, and there is already evidence that even an honours degree in a branch of technology has no advantage over an honours degree in a branch of science when the general training accompanying the latter has been broad and sound Moreover, it was evident in the discussions at Glasgow that the possession of a 'pass' degree with its grounding in several branches of science is regarded with increasing favour as a satisfactory qualification for entry even to the smaller firms, where promotion may be to chief chemist or engineer, works manager, or the like A recruit is not expected to possess a large stock of practical knowledge, but high scientific qualifications and a capacity for independent work

These reasons alone may lead to some change in the functions which technical colleges fulfil in the social and industrial conditions of to-day Apart from this, there are other factors which are tending to change the functions of university education also The emphasis on the utilitarian aspects is diminishing Education is no longer supported, as Prof Greenwood pointed out, on the ground that the technical efficiency of the educated is in the long run greater than that of the merely instructed, that an educated nation would be better fitted to secure advantages in the international struggle for markets than an uneducated nation Already there is a demand for higher education for its own sake, not for some material or social advantage it confers but as a path to happiness

This change is highly significant. It bears closely on the problem of leisure and on the raising of the school-leaving age It is one of the weightiest objections to the trade continuation school advocated by Sir Kenneth Lee and others as alternative to raising the school-leaving age The more nearly education at whatever stage succeeds in teaching principles, not practice, in training the mind without neglecting to train the hand, and in sending out those whose training and outlook enable them to attack with confidence the new problems that are perpetually arising, the more it will provide society with those who are capable of adapting themselves quickly and harmoniously not merely to particular industrial positions but also to the utilisation of leisure and the problem of citizenship generally

Such questions cut deeply into our whole educational system As Mr H T. Tizard pointed out in his presidential address to Section L (Educational Science) at the Aberdeen meeting of the British Association last year, it is no simple matter to encourage a broader education. A policy of making scholarships in science deliberately available for those who have not specialised in science, which the Imperial College of Science and Technology has initiated, would do much to discourage that excessive and premature specialisation in science at school which is a root cause of the lack of culture and sense of values possessed by many honours graduates in science to-day. Such a policy, however, cannot succeed unless it is supported both by the schools and the larger universities, and as Mr Tizard trenchantly remarked, if it is not considered worth while to reform the university matriculation examination in this way, criticism of the general education of the science student loses most of its point

There is a further point to be considered in this question of education for life, for leisure as well as for industry Prof Greenwood suggested that the total collapse of political freedom throughout the greater part of Central and Eastern Europe is mainly due to the fact that the populations were not educated at all Instruction may be confused with education when it is a mere question of technical skill for some particular occupation Such confusion can never exist when we consider the effect on the whole man, and recent events in Germany have made patent the defects in elementary instruction as compared with education Moreover, the evidence suggests that the present rulers of Germany, so far from making higher education more accessible to the public, are deliberately making it less accessible

These considerations are not lightly to be dismissed. The dissociation of higher education from industrial or social status may be an essential element in a policy which will provide society with citizens possessing the requisite background of knowledge in this scientific age, for the adequate discharge of civic duties no less than to meet industrial needs. The mere increase of technical efficiency will not avert disaster. The capacity to live fuller and happier lives, to enjoy leisure with less dependence on the service of others—these are closely related to the question whether civilisation is to gain control over the forces placed in its hand or whether it is to relapse as a whole into comparative barbarism.

The functions of a university in the world of to-day cannot be considered apart from the functions of education as a whole It is no longer sufficient for the universities to provide society with the leaders it requires in the professions, in industry or in the State More and more it has to assist in developing that background against which constructive virile citizenship is possible, to provide in every sphere of life the mental stimulus and corrective to those habits of mind and tactics which, carried over from an old order, are obstacles to the development of the new It is in this sense that, as Col A G Lee remarked at the recent Conference of Industrial Physics in Manchester, we require more social workers, and that organisations such as the Institute of Physics should seek to awaken the country to the necessity of adjusting physical discoveries to the rate of advance in economic affairs, so that we can enjoy the leisure and wealth created by the physical sciences

The ideals of a university set forth by J H Newman, Mark Pattison and Walter Bagehot or J S Mill, in essentials, differ little from those expressed by Dr Abraham Flexner or Prof Alexander in recent years Their functions, on the contrary, are rapidly changing, and the future of civilisation depends largely on the skill with which the functions of the universities are adapted to the needs of to-day Mechanical organisation is never an adequate substitute for effective social organisation or for a sound biological adaptation, and Prof Greenwood's address should stir scientific workers to probe far more deeply into the question than merely to discuss the best training to be given to chemists or physicists for industry From the universities, after all, must come once more that floodtide of intellectual life, that spirit of unprejudiced search for truth, which will disdain merely to copy, and will ensure that the mechanisation of life proceeding so fast, follows, not the economic or technical pattern of the past, but develops new structures adapted for the purposes of to-day, and releases for mankind a wealth of creative energy and intellectual power worthy of the discoveries which gave them birth

Reviews

Bull-Worship in Ancient Egypt

The Bucheum By Sir Robert Mond and Oliver H Myers With Chapters by T J C Baly, D B Harden, Dr J W Jackson, G Mattha and Alan W Shorter, and the Hieroglyphic Inscriptions edited by H W Fairman (Forty-first Memoir of the Egypt Exploration Society) Vol 1 · *The History and Archæology of the Site* Pp. xii+203 Vol 2 · *The Inscriptions* Pp iii+92 Vol 3. *The Plates* Pp iv+173 plates+iv. (London Egypt Exploration Society; Oxford University Press, 1934.) 50s net

NO animal has had a more consistently honourable place in the life of the Egyptians than the ox The earliest human settlements contain remains which indicate the domestication of cattle, while the special treatment of skeletons in an associated cemetery suggests some sort of veneration already at this date Before the historic period, ox-headed amulets have appeared The famous ceremonial palette of the First King of the First Dynasty depicts the Pharaoh as a bull trampling his enemies underfoot—a conception to be made explicit 1500 years or so later, and maintained thereafter until the end of the Dynasties, by the inclusion of a "Strong Bull" name in the royal protocol. Hathor was not the only cow-goddess, and mythology could show other bulls and cows who did not claim the full status of divinity To-day the buffalo, though often with a camel for yoke-mate, draws virtually the same plough as is to be seen behind the cattle on the walls of tombs of the Old Kingdom Small wonder that the three sacred bulls, the animal theophanies of three different and major gods, of the separate worship of which we are certain, are among the most important animal cults known in ancient Egypt.

Bull-worship in Egypt is in fact a large subject for which a great deal more evidence and study is required before much can be said about it, and even the elaborate researches underlying the three volumes under review admittedly only approach the subject Of the three great cults, that of Apis at Memphis-Saqqarah is the best known, and has left behind the most concrete remains But the great underground cemetery of these bulls was excavated more than eighty years ago, when methods were less scientific than they are to-day, and a mass of invaluable information, from a site which was for many reasons much richer than that of the Bucheum, was lost. The ancient worship of Apis, however, was used by the Ptolemies as a basis for a mixed mystery cult for their Greek followers, and in the new name of Serapis spread beyond the borders of Egypt. While the crumbly soil of the Bucheum easily gave way, frequently before the excavator's eyes—as it evidently must have done while the mausoleum was still growing—the vaults of the Serapeum remain to-day one of the important sights of Egypt The burial stelæ of Apis have given us invaluable chronological checks for the twenty-sixth dynasty His worship can be shown to go back to the Old Kingdom In short, the sum of our knowledge of Apis, always the most important, is much greater than that of Buchis, perhaps the least of the three sacred bulls Hence a brief account of Apis has been given in "The Bucheum" as the basis of the attempt to reconstruct the story of Buchis On the other hand, much that was known about Apis at second hand only has been confirmed by the actual remains in the cemetery of Buchis, while our knowledge of the original appearance of the Apis burials and their method have been very largely supplied by the careful excavation of the other

From Mnevis, the bull sacred to Rē' at Heliopolis, little help is to be had Only two of his tombs have been opened But from contemporary literature, it appears that his cult was older and more important than that of Buchis—as old, probably, as that of Apis

There is singularly little material from which to write the history of Buchis Under that name he does not come into existence until the reign of Nekhthorheb of the last native Egyptian dynasty —a king who gave marked encouragement to the indigenous cults of Egypt and especially that of Apis The name Buchis (*Ba-hr-khet* or *Bakhe* in Egyptian), however, seems to have been no more than an enhancement of the status of a sacred bull which had represented from the eighteenth dynasty, if not from the twelfth, the God Mentu of Thebes in four different appearances, corresponding with four different towns of the Thebaïd

At the same time, it is evident that he was even more intimately connected with Rē'. But while bull worship in Egypt was always connected with solar religion, it is by no means clear that Mentu himself was originally a bull-god. Anterior to the twelfth dynasty, it is not possible to trace the bull that became Buchis, unless we assume that his worship was instituted at that date as a southern counterpart of Mnevis For Hermonthis, the seat of Buchis eventually, was called in Egyptian 'Southern *On*', while Heliopolis, or *On*, in the north, was the home of Mnevis

"The Bucheum", then, is the definite publication of the excavation of the cemetery of the sacred bull Buchis and that of the cows who had borne Buchis bulls. The cemeteries lie in the desert two or three miles west of the site of Hermonthis (modern Armant) and about ten miles south of Thebes. Their discovery (in the archæological sense) was not an accident. Native plunderers had already placed objects now recognised as from the Bucheum on the antiquities market, and there were stories going about which might or might not mean anything Armed with these fragments of evidence and the brief references to the bull in classical authors, Mr W B Emery, at that time excavating among the tombs of Gurneh for Sir (then Mr) Robert Mond, spent the greater part of his leisure examining the desert nearest to the village of Armant, where he was confident a second Serapeum was to be sought It was a carefully worked-out investigation, and the first fortnight's work showed the excavators that they had landed on top of the cows' vaults The next season, again initiated by Emery, though under the general direction of Frankfort, they dropped directly on to the most sumptuous of the bulls' burials The success that followed, and finds completion in the present publication, has no doubt obliterated from most minds the memory of the almost universal scepticism, in the face of which Sir Robert Mond decided to move his dig from the classical site of the Theban necropolis to a barren stretch of ground which his colleagues promised would yield only a mare's nest

If unusual courage and judgment was shown at the outset, the conclusion in the form of the publication is even more remarkable Excavation reports are as a rule highly technical affairs and dull enough as general reading The excavation of Buchis yielded about forty tombs of bulls and as many cows, all subterranean Little is now to be seen on the site, and except for the stelæ, not much more in museums There are singularly few concrete remains—for a number of reasons—of what was a most important phase of Egyptian life With one very interesting exception, the sum of our new knowledge resulting from the excavations is confined to a comparatively small, though important, sector of the field of Egyptological research Yet it has taken three large volumes to say all this, and generally speaking, not only is the size of the publication justified, but also it may be said to constitute a step forward in archæological science, and to set up a new standard for future work

"The Bucheum" is an advance on previous excavation memoirs for two reasons First it is an attempt to deal fully and finally, in so far as the material is available, with the field of study illumined by the excavation of the Bucheum, not merely to record those excavations and draw inferences from them, *within a year or two after the close of work on the site* Secondly, the principle of seeking expert opinion on every detail of the find has been carried out in it to a greater extent than in any other work of this kind known to the reviewer. There are in fact thirty contributors to the book, specialists ranging from Coptic to musical instruments, from petrology to Arabic inscriptions, besides another score of experts named whose opinions have been taken on specific points To Mr O H Myers has fallen the task of holding the team together, and since there was something in the nature of pioneering about it, some unevenness was to be expected and may be passed over Mr Myers has also contributed, as director of the excavations during the last two seasons' work, the bulk of the chapters on the history of Buchis, the site, architecture, etc, together with a very elaborate study of the Demotic ostraca, full transcriptions and translations of which form a separate chapter by Mr G Mattha in vol 2

The outstanding contribution to the work, both for its scholarship and as the main source of new knowledge acquired, is the chapter by Mr. H W Fairman on the hieroglyphic inscriptions The bulk of these, and the most important, are the stelæ set up to each bull, on which are recorded the dates of their birth, installation and death, together with their ages Here and there an additional comment of historical or sociological importance creeps into the more or less stereotyped formulæ in which the ceremony of installation is described Once, by the mention of a queen in a royal titulary, whom Fairman proves to be none other than Cleopatra VI, we are lifted for a moment out of the academics of a little-known animal cult in Upper Egypt, into the heart of international politics in a world disputed by Antony and Octavian How significant such a small detail may be is to be read in Mr. W W Tarn's chapter on "The Triumvirs" in vol. 10 of the "Cambridge Ancient History", where Cleopatra's installation of a new Buchis at the beginning of her reign provides important evidence for her popularity with the Egyptians and for her support of the native religion

Sir Robert Mond has set up a new standard in archæological publications, which will not easily be repeated. The expense involved in the production of such a work, requiring considerably longer and more concentrated research than can be squeezed into the leisure between successive excavation seasons, is in itself beyond the purse of most bodies such as the Egypt Exploration Society, which was responsible for the greater part of the excavation and for the publication of "The Bucheum" Sir Robert not only provided those funds, but has also allowed the book to be published at a price within the reach of students, to whom a three-volume memoir of this size would normally be unavailable. It is in fact a standard which can only be maintained so long as archæology can find patrons.

The New Knowledge of Hydrogen

Orthohydrogen, Parahydrogen and Heavy Hydrogen. By Dr Adalbert Farkas (Cambridge Series of Physical Chemistry) Pp xiv + 215 (Cambridge At the University Press, 1935) 12*s* 6*d* net

WHEN chemists are told that since the principles governing the outer sphere of the atom are now established, there is little interest left in pure chemistry, they should turn for comfort to contemplate our new knowledge on hydrogen The book under review will give them competent guidance

The first half of the book deals with the ortho- and para-modifications of hydrogen proper, the second (smaller) half with heavy hydrogen Whilst the former presents a well-established body of knowledge, the latter outlines the beginnings of a new, yet unlimited, field of research

The author, well known by his researches on ortho-, para- and heavy hydrogen, marshals the various features of his subject with equal ease The quantum mechanical theory and the spectroscopic evidence by which the existence of ortho- and parahydrogen were predicted, the delicate heat conductivity method by which the ortho and para contents of hydrogen are determined, the theory of heat capacity and of other thermodynamic properties of the two modifications are set out with equal precision The problems of chemical kinetics, arising from the wide range of observations on the conversion of orthohydrogen into parahydrogen are discussed with similar mastery of facts and theories

To the chemist, these various conversions are the most interesting part of the subject Not all conversions are based on atomic interchange between a pair of molecules Comparison with the reaction

$$H_2 + D_2 = 2HD$$

has now definitely established this fact

The interchange between the atoms of hydrogen molecules is caused by the contact with hydrogenating and reducing catalysts Comparison between the catalysed process of atomic interchange, and the catalysis of the chemical reactions of hydrogen, will show definitely whether this catalysis is based on a preliminary breaking up of the hydrogen molecule, or whether we have to envisage other methods of 'activation' of the hydrogen by the catalyst

A wider scope for the study of the atomic interchanges of hydrogen which accompany chemical reactions is opened by the discovery of heavy hydrogen The presentation of this discovery and of the rapidly growing knowledge derived from it embraces the most varied aspects, ranging from nuclear disintegration to the metabolism of bacteria. Here again we find theory and experiment presented with equal clarity.

This review of our knowledge of heavy hydrogen will be welcomed just as much as the presentation of our knowledge of orthohydrogen and parahydrogen. The linking up of both subjects in one volume may, however, have some disadvantages. The rapid advancement of research on heavy hydrogen tends to make a review written to-day soon become obsolete. It would be regrettable if this should endanger the future popularity of the book, the first half of which will probably retain its usefulness for a long time.

The enduring value of the book lies in the fact that it sets an example for the new spirit of physical chemistry, in which the fusion of physics and chemistry, of theory and experience, should be complete.

Introductory Logic

The Principles of Logic: an Introductory Survey. By C. A. Mace. Pp. xiii+388. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 12*s.* 6*d.* net.

MR. MACE'S purpose is to help students who begin the study of logic, and to supply them with a mental discipline by acquainting them with genuine logical problems rather than by forcing upon them the technicalities of traditional exercises. The "Principles of Logic" will be found extremely valuable by all those who already know some logic. But it is difficult to say whether beginners could master in one year the theories and problems so excellently treated in this book. The increasing complexity of logical systems makes it more and more difficult to teach logic in its present-day setting to first-year students, who may not have much natural aptitude for the subject and cannot have the philosophical training which, in all fairness, should be assumed for a serious reading of Mr. Mace's book.

The pedagogical problem involved concerns less the students or the teachers themselves than the actual status of logic in our educational system. In order to make sure that students master the rudiments of sound reasoning before attempting prematurely to deal with problems which may be beyond them even later on, lecturers have to check their natural inclination to acquaint their students with some fundamental developments of logic. This difficulty could be easily redressed if logic were given a place in our schools.

Without attempting to deal here with the various details of the theories so very ably analysed and explained, we may indicate two of the principal features of the book. A chapter on the "General Theory of Deduction" introduces in a simple way the principles of symbolic logic; and, secondly, the author has taken great pains in bringing together, often with important additions of his own, the contemporary efforts to improve Mill's theory of induction. Though Mr. Mace treats his problems without exhibiting a partisan attachment to a school, he nevertheless favours the views of logical analysis as against the ontologism of the Aristotelian tradition; while, in the last chapter of his book, he seems to share a kind of pragmatism which may easily turn to scepticism. But after all, is it possible to have any logic without some conscious philosophical background?

Short Notices

Index Generalis. Quinzième édition française. Annuaire général des Universités et des Grandes Écoles, Académies, Archives, Bibliothèques, Instituts scientifiques, Jardins botaniques et zoologiques, Musées, Observatoires, Sociétés savantes. Publié sous la direction de Dr. R. de Montessus de Ballore. Pp. vi + F176 + US228 + BE232 + 1284 + 1921 to 2462. (Paris: Éditions Spes, 1935.) 225 francs.

THE "Index Generalis" began publication shortly after the close of the War, when "Minerva", hitherto the standard reference work to the learned world, had suffered considerable reduction of size. "Minerva" has developed since then into two portly volumes, but the price in English money effectually prohibits their general use except in the wealthiest of institutions. The "Index Generalis", now in its fifteenth year, is a useful single volume substitute.

For those not familiar with the "Index", its arrangement is a little peculiar. The first section deals with the university institutions of France and its colonies, including a brief statement on general entrance conditions and, under each institution, number of students, budget and a list of the staff with their subjects. These page numbers are preceded by the letter 'F'. Succeeding sections, each with fresh pagination and with the letters 'U.S.' and 'B.E.' respectively, deal similarly with the United States and the British Empire. The remaining countries of Europe, Africa, America and Asia are covered in the next section, which again has new pagination, but without distinguishing letters. Succeeding sections, the pagination continuing, contain details of observatories, libraries, scientific institutions and learned societies respectively, the entries being arranged alphabetically by countries. Then comes the alphabetical index of the personnel named in the text, reference being facilitated by the addition to the page number of a numeral (1–8) indicating position on the page. A useful list arranged by subjects gives the names of those willing to exchange publications, and there is a geographical index

The 1935 issue of the "Index" is now available, and the 'working part', the index of personnel, runs to 443 three column pages of small but clear type The volume should be of service to all who have occasion to deal with scientific and learned institutions The information published, for the insertion of which no charge is made, is obtained directly from the institutions themselves, and the editor, Dr. R de Montessus de Ballore, Sorbonne, Paris, 5, informs us that he welcomes corrections and additions to his valuable handbook We hope this hint will catch the eye of those responsible in the U.S.S.R for the lack of information from that country

Rayleigh's Principle and its Applications to Engineering · the Theory and Practice of the Energy Method for the Approximate Determination of Critical Loads and Speeds. By Prof G Temple and Prof W G Bickley Pp. ix + 156 (London Oxford University Press, 1933) 14*s* net.

PROFS TEMPLE and Bickley have exemplified and extended a principle put forward by Rayleigh so far back as 1877, a principle which, concerned primarily with the calculation of the fundamental frequencies of vibrating systems, has applications to problems of elastic stability, and to various equilibrium configurations of interest and importance to engineers. In the words of the authors, the principle may be enunciated briefly, thus "In the fundamental mode of vibration of an elastic system, the distribution of kinetic and potential energies is such as to make the frequency a minimum".

Suppose, then, we are faced with a vibrating system the fundamental frequency of which we find it difficult, or impossible, to compute Let us constrain the system to vibrate in a specified manner in which the mode of vibration is (mathematically) known, and approximates as closely as may be to the mode of vibration of the actual system We can, by an application of the energy method, calculate the frequency of this artificial system ; and the frequency of the actual system will, in general, be less than (in some limiting cases, equal to) this calculated frequency. The difficult task of determining the magnitude of the error has been attacked by Dr Temple, and we are fortunate in possessing in such an easily accessible form the record of his very interesting results.

The power of the method is shown by a series of thoroughly practical illustrative examples, and the book, which is a very important addition to the literature of physics and engineering, has been written with a mind sympathetically disposed to the capacities of those weaker brethren to whom an austerely mathematical argument makes but little appeal. Which is not to say that the book lacks in mathematical rigour, but merely to hint that easier paths are provided for the less mathematically minded. A. F.

Physique moléculaire matière et énergie Par Prof. Victor Henri. Pp 436 (Paris · Hermann et Cie, 1933) 110 francs

THE present time appears particularly appropriate for an attempt to form a complete picture of our knowledge concerning matter and energy. Starting from the early controversies fought around the question of continuity and discontinuity, the author describes the origin of the atomic hypothesis, the idea of chemical elements and their periodic classification, and the methods of determining Loschmidt's or Avogadro's number This is followed by an account of the properties common to all chemical elements, a history of the atom and of its spectral manifestations. The essential features of radioactivity, radioactive elements and isotopes are set out in an easily intelligible and attractive form Throughout the book are scattered many historical data, useful formulæ and illustrative numerical examples Particular praise must be given to the line diagrams which are, with few exceptions, models of clearness

Handbuch der wissenschaftlichen und angewandten Photographie Herausgegeben von Alfred Hay Band 6 *Wissenschaftliche Anwendungen der Photographie* Teil 2 *Mikrophotographie* Bearbeitet von T Péterfi Pp ix + 432 (Wien und Berlin : Julius Springer, 1933.) 51 60 gold marks.

THIS book gives a very full account of the modern state of photomicrographic technique in Germany. It constitutes, in fact, not only a textbook of the practice of the various methods, but also a fairly representative handbook on the apparatus manufactured by the various optical firms

The trouble with a work of this kind is that its detailed character makes it difficult to read as a textbook It can only function as a reference book, but as such it cannot fail to be of use to a serious worker. It is well printed and illustrated, and those who have occasion to use photomicrographic methods will be indebted to its author for such a useful piece of work

Check-List of Birds of the World By James Lee Peters Vol 2. Pp xvii + 401 (Cambridge, Mass. : Harvard University Press London Oxford University Press, 1934) 17*s*. net.

THE appearance of the first volume of this most useful adjunct to the work of the scientific ornithologist has already been welcomed in NATURE It is a book purely for reference, consisting of a systematic list of all known birds, with the authorities for the names used and the distribution of each form The like has not been attempted on a world-wide basis for a generation, and as the plan and execution are admirable the completed work should be of great service This second volume covers three great cosmopolitan orders—which incidentally include most of the birds of special interest to sportsmen—the megapodes and game-birds, the cranes, rails and bustards, and the plovers, gulls and auks.

The Oxford University Arctic Expedition, 1935–36

By A. R. GLEN and D. B. KEITH

AN interesting feature of post-War university life has been the active part played by Cambridge and Oxford in exploration. This activity has by no means been limited to a few places, and to mention only one or two of the places visited, Cambridge expeditions have carried out useful work in various parts of Africa and in Greenland, while Oxford expeditions have obtained valuable scientific results in South America, Borneo and Spitsbergen. The first of this kind to spend a winter in the arctic was the British Arctic Air Route Expedition of 1930–31, and the expedition which was organised by Mr. E. E. Shackleton and led by Dr. G. N. Humphreys, now making its way from Etah to Ellesmere Land, is the first Oxford expedition to winter.

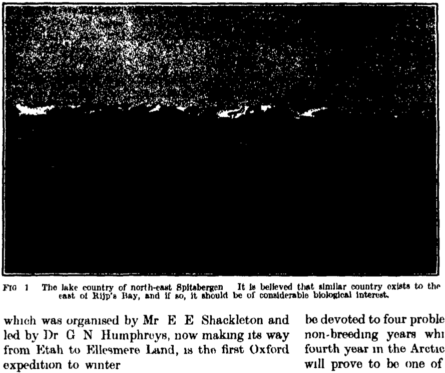

FIG. 1. The lake country of north-east Spitsbergen. It is believed that similar country exists to the east of Rijp's Bay, and if so, it should be of considerable biological interest.

In July, another Oxford expedition is leaving England to spend fourteen months on the north coast of North-East Land. It is being organised by Mr. A. Dunlop-Mackenzie; Mr. A. R. Glen, leader of the 1933 Oxford University Arctic Expedition, is going as leader. The personnel of nine is made up by three surveyors, two physicists, a wireless operator, a glaciologist, a doctor who will also be in charge of the marine biology, and a dog-driver. The last, Mr. Andrew Croft, was a member of the British Trans-Greenland Expedition of last year, and will be second in command of the present expedition.

The sealer, the M.S. *Polar* of Tromsø, has been chartered, and it is hoped that the north coast will be reached during the first week of August. A base hut will be built near the head of Rijp's Bay, and after all the stores and equipment have been landed, the ship will return to Norway. The plans are to carry out a topographical and geological survey of the unknown north and east coasts and of as many of the northern and eastern islands as time and ice conditions permit. In addition to the surveys, researches on the ionosphere, atmospheric ozone, electrical disturbances and terrestrial magnetism, will be carried on at the base over the whole year, and two winter stations are to be maintained on the inland ice with the intention of trying to form an estimate of the present balance of glacial conditions, as well as investigating the crystallography of surface snow, firn, and of blue and white ice.

Finally, a fairly comprehensive biological programme is planned, and the land side of this, which will consist mainly of a study of the birds, will be under the direction of Mr. D. B. Keith, while the marine work will be in the care of the doctor.

In addition to general observations on the bird life, special attention will be devoted to four problems. The first is that of the non-breeding years which seem to occur every fourth year in the Arctic. It is probable that 1936 will prove to be one of these, and if this should prove to be the case, the gonads of selected species will be examined (and preserved) in May, June and July, and an attempt will be made to discover if there is any evidence that the non-breeding is connected with the weather conditions of the summer or of the previous winter. It has also been suggested that exceptionally late breaking of the sea ice, or late melting of lake ice, might cause interference with the food supply of the birds, and this, together with any other factor affecting the food supply, will be examined. In the event of 1936 not being a year of extensive non-breeding, estimates of the proportion of breeding to non-breeding birds will be made, and this may give interesting results, as it is a subject on which very little work has been carried out.

It is hoped that it will be possible to make a detailed study of the snow bunting throughout the breeding season, with special reference to territory Much work has been done and is being done at home on the breeding and territorial habits of closely allied species, and this should prove a valuable comparison, for not only is the habitat so vastly different from that of the species already studied, but also the snow bunting is the most northerly passerine and hence has no food competitors in the form of other passerines The bird distribution will also be analysed from the point of view of food supply and nesting sites

FIG 2 One of the first colony of ivory gulls to be discovered in western Spitsbergen by the Oxford 1933 Expedition

During the Oxford 1933 Expedition in Spitsbergen, Mr Hartley and Mr Fisher (*Geog J*, **84**, Aug, 1934) carried out a detailed study of the marine feeding of sea birds, and correlated the facts with the conditions of the marine fauna investigated by Mr Stott The fulmar petrels and kittiwakes were found to have a feeding zone about 100 yards long and 50 yards across, close to the ice cliffs of the Nordenskiold Glacier, at a point roughly half way from either shore (Fig 3) This zone remained a permanent feature during July and August, and the normal number of kittiwakes was about 3,000, while that of the fulmars varied between 500 and 700, but these numbers rapidly decreased in the beginning of September From analyses of a large number of stomach contents, the food was found to consist almost entirely of the Euphausid *Thysanoessa inermis*, although an amphipod, *Euthermistes libellata*, occurred occasionally in small numbers It was also found that *Thysanoessa* was the basic food of Arctic terns, Brünnich's guillemots and little auks, and also had place in the food of puffins, although these were mainly fish-eaters, and of Mandt's guillemots, which were found to feed also on the general bottom fauna of the inshore zone Thus it is of the greatest importance to the bird population, and it is probably only through the blanketing effect of the silt brought down by en-glacial and sub-glacial streams that it is able to live in the extreme surface layer in this area As a large glacier flows from the west ice of North-East Land into Rijp's Bay, and as it is the only glacier with a sea face in the bay, it will be of the greatest interest to discover whether the phenomenon is repeated in this area, and also whether it occurs in the other bays of the north coast of North-East Land

The 130 miles of almost continuous ice cliffs on the east and south coasts may give interesting conclusions, especially as there are several islands off the northern part of the east coast which may offer suitable nesting sites It is not intended to repeat this study in the detail with which it was carried out in 1933, but rather to see if the birds in these areas resort to these definite feeding zones, and to discover what effect the zones—if any—have on the distribution of the birds The work will probably be correlated by observations on the marine fauna, and this will be under the direction of the doctor, who is the only member of the expedition not yet appointed

Little is known of the breeding habits of the Spitsbergen ptarmigan, and there are no skins of the bird in breeding plumage or of the chicks at the British Museum (Natural History) It seems likely that the birds breed on moderately high ground, and that they come down to the coasts and low unglaciated ground when the snow limit becomes lower with the approach of winter Attempts will be made, therefore, to find their breeding places and to examine their winter distribution, as well as the change brought about in this by the approach of spring Some years ago, reports were brought back from the Ice Fjord region of Spitsbergen that there were remarkable

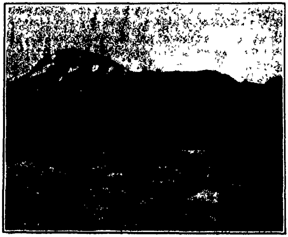

FIG 3 Nordenskiöld Glacier sea face showing the cave in front of which was the zone frequented by fulmars and kittiwakes

fluctuations in the numbers of the ptarmigan, but it is very possible that the reports of the scarcity of the birds were made on the evidence of the summer months, when the birds may have been on relatively high ground One of the parties of the Cambridge 1932 Spitsbergen Expedition spent some time in the Wijde Bay, and while there, found a considerable number of ptarmigan above the 1,500 ft level Only on one occasion, and then towards the latter part of August, were birds found below that height Similarly in 1933, the Oxford Expedition in the north-eastern part of the Ice Fjord found only one family of ptarmigan during July and August, but in September large numbers of the birds were found in the low valleys, the snow level by that time being at about 600 ft The reports of number fluctuations may thus, in part, be due to variations in the autumn weather conditions at the time when the ptarmigan are likely to be driven from the high ground by the approaching winter into the valleys, where they are most easily seen

It is hoped that it may be possible to bring back the skins of certain species required by the British Museum (Natural History) Some collecting will be undertaken with the view of ascertaining crop and stomach contents, and all birds shot will be examined for lice, as the parasites of arctic birds are very little known All bears and seals shot will likewise be examined for parasites Every effort will be made, however, to restrict the shooting and hunting to a minimum, as the history of the fauna of Spitsbergen during the last fifty years shows only too clearly the havoc wrought by indiscriminate slaughter, although the efforts of the Norwegian Government during recent years are meeting with a well-merited success

The general observations will include notes on such subjects as numbers, distribution, time of arrival and time of departure, and as no observations of this kind have yet been made from North-East Land, they may produce some interesting results The only information brought back during the spring was that gained by Nordenskiold as a result of his journey with Palander in 1873 along part of the north coast The first birds to be seen after the winter were some glaucous gulls on March 3, and on April 3 the first snow bunting arrived By the middle of May millions of sea birds had arrived in the fjords and were breeding on the precipitous slopes of the surrounding mountains, notwithstanding that there was no open water in the near neighbourhood The length of time to be spent in North-East Land by the present expedition ought to give every opportunity for comprehensive study of this kind

The remainder of the work will consist of straightforward botanical collecting, and will aim at making as complete an ecological survey as is possible It is hoped, however, that it will be possible to make a detailed investigation of surface markings, and especially of the polygonal markings which appear to be characteristic of arctic and, to a less extent, of Alpine regions Various studies have been made of these, and perhaps of greatest interest in this respect is the work which has been recently carried out by Mr N Polunin It seems to be probable that the causes vary from place to place, and that no generally applicable theory can be framed , the investigations of the growth of the polygons over the year may, however, throw some fresh light on the subject

Weather conditions naturally will control the degree in which the biological programme of the expedition is carried out, although it is much more independent of weather than the survey, for example With a working period of fourteen months, there is ample scope for varied work The expedition expects to return during the late summer of 1936

Cancer and the Theory of Organisers

By C. H WADDINGTON, Christ's College, Cambridge

THE fundamental fact about cancerous tissue is that it has escaped from the normal growth-controlling agents of the body The escape often involves a change in histological type The problems which are raised are clearly connected with those studied in experimental embryology, where again it is the causal mechanism underlying growth and histological change which is under investigation Experimental embryology has recently made important advances, and the time has perhaps come when it would be profitable to consider the way in which the new embryological theories would formulate the well-known problems of cancer research.

The illuminating researches of Spemann[1] provided the beginning of an answer to the outstanding embryological problem of why one part of an egg develops into one organ and another part into a different organ. Spemann showed that in the amphibian gastrula the developmental path followed by any given piece of tissue is defined by its relation to the blastopore region, which was therefore termed the organisation centre. Further research has shown that one facet of the activity of the organisation centre consists in transmitting a stimulus to the ectoderm which comes to lie above it, causing the latter to develop into the neural plate. This is a two-term reaction, between the stimulus (or evocator[2]), emanating from the organising roof of the primitive gut, and the overlying ectoderm. The ectoderm, it was found, will only react when it is in a reactive, or 'competent'[3], state Very little is known about the nature of competence or how it is acquired, probably changes are proceeding within the cells from the time of fertilisation onwards eventually bringing them into an unstable state, when the evocator-stimulus is able to push them into one developmental path or another The evocator stimulus has been shown to be due (both in the amphibia[4] and in birds[5]) to the presence of a chemical substance, as to the nature of which a great deal of research is being carried on at the present time

The two concepts of evocators and competent tissues can be applied, with some modification, to the consideration of cancer. There is little evidence that the susceptibility of adult tissue to cancer-provoking agents varies in the same way as the competence of embryonic tissue varies with the passage of development, although the fact that cancer is to some extent an old-age disease may be suggestive in this connexion. But as between different individuals, the genetic differences in susceptibility to cancer may be considered as differences of competence in the genetically different tissues Again, changes of competence need not be due to internal causes Thus it has been suggested[6] that the mammary gland must be acted upon by œstrin before it is capable of reacting to the specific lactation hormone One can phrase this either as a case in which œstrin brings about a change in the competence of the mammary gland, or one in which lactation depends on the consecutive action of two evocators In dealing with the facts of the inception of cancer, it may be necessary to envisage similar chains of reactions

Many types of cancer-producing stimuli, or 'cancer-evocators', have been described viruses, specific chemical substances, spontaneous changes in the metabolism of the cells, general irritating agents, etc. Particular interest is attached to the sterol-like substances recently isolated and synthesised by Kennaway, Cook and their collaborators[7] The evocator of the amphibian neural plate probably belongs to the same group of substances[8]. In fact the similarity is so close that one at least of the synthetic carcinogenic substances, namely, 1 : 2 . 5 . 6-dibenzanthracene, is probably capable of acting as an evocator when introduced into the amphibian gastrula[9]. The reciprocal experiment cannot yet be made, as the evocator has not yet been purified Woerdeman[10], some time ago, had the idea that cancer tissue might be able to act as an evocator, and succeeded in confirming the suggestion, but unfortunately it did not occur to him that all adult tissues might have the same capacity, and he made no controls to exclude such a possibility. Later work by Holtfreter[11] and others has shown that this is in fact the case, and it is still unproved that the evocating properties of cancer tissue are any different from those of any other part of the body Holtfreter also made the very important discovery that the newt evocator is present throughout the whole egg, although it is active only in the region of the organisation centre In the remainder of the egg it can be activated by any process which coagulates the cell proteins One immediately searches for some metabolic peculiarity of the organisation centre which might explain the liberation of the active evocator in that region The most striking feature which has been discovered is the extremely rapid disappearance of glycogen[12] The activation of the evocator may not be necessarily connected with this glycogen anabolism, but the facts suggest that interesting comparisons may be possible between the metabolism of the organisation centre and that of tumour tissue

The analysis of development into evocators and competent tissues is only half the story. The organisation centre is not uniform, one part of it stimulates the ectoderm to form the neural plate of a head, while another part induces the formation of the spinal column[13] These regionally different effects cannot be accounted for by the mere presence of one chemical substance, they necessitate the assumption of a regional distribution of one or more active substances within the organisation centre. The processes by which different parts of the centre induce the formation of different definite organs are spoken of as 'individuating actions', and the organisation centre is said to be the centre of an 'individuation field'[2] The main characteristic of an individuation field is that all tissue lying within it tends to be built up into a complete embryo, and in any one part of the field all tissue tends to be built up into the organ corresponding to that part

The individuation field, then, is the agent* which controls the growth of the different parts in a harmonious way so that a normal individual is formed In later life, the individuation field splits up into smaller separate fields, such as leg fields, head fields, etc These are the agents from which cancerous growth has escaped In mammals their effects are normally not very striking, their influence is confined to the control of the minor repair growth of the body, and they are probably capable of very little more than this The adult fields, however, are much more potent in those animals in which regeneration is possible In the newt, for example, the leg field can mould into a limb any mass of competent tissue either grafted into it or formed as a regeneration bud

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* This is a convenient but loose form of expression The field really expresses the formal properties of the distribution of the unknown growth-controlling agents

Possibilities of the experimental testing of the action of powerful individuation fields on cancerous tissue immediately suggest themselves Is there a difference in the susceptibility to cancer between the Urodeles, which have a high capacity for regeneration, and the Anura, which have a low capacity ? If there is, is the difference due to the presence of more potent individuation fields in the Urodeles, or to a greater competence of their tissue for proliferation ? In some animals there are differences in the capacity for regeneration in different organs , one would like to know whether these differences are correlated with differences in the susceptibilities of the organs to cancer, or with the behaviour of tumour tissue transplanted to the various sites

Once the problem of the relation of cancer to the individuation fields has been stated, the methods of attack are legion Some work has already been begun ; cancer tissue is being transplanted into embryonic regions where powerful fields are at work, and the influence of carcinogenic agents on regeneration is being investigated. But the embryological approach to the study of cancer has been stated here in the hope that workers whose experience has brought them into closer contact with the facts of the incidence of cancer may be led to see whether this point of view may not enable valuable conclusions to be drawn from the facts which are already known

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[1] Spemann, H , *Arch EntwMech* , **43**, 448 , 1918 *Arch EntwMech* , **100**, 599 1924

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[5] Waddington, Nature, **131**, 275 , 1933 *J Exp Biol* **11**, 218 , 1934

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Obituary

Sir Edward Sharpey-Schafer, F R S

THE death of Sir Edward Sharpey-Schafer at North Berwick on March 29, in his eighty-fifth year, will be greatly regretted all the world over His method of resuscitation of the apparently asphyxiated, for which he was awarded the Distinguished Service Medal of the Royal Life Saving Society in 1909, brought him well-merited fame. Public notices describing the method and placed in conspicuous situations wherever there is danger from death by drowning and gas poisoning, and its use by all first-aid societies and ambulances, have rendered its discoverer the best known of all physiologists so far as the general public is concerned.

Sharpey-Schafer was a genius in the realm of physiological research and teaching. In all his work he was remarkably lucid and arranged his facts in a very interesting and refreshing manner, keeping his lectures alive by frequent reference to the researchers who were responsible for the work under consideration. Both in his discourses and in his writings he fully realised the value of demonstration and used cleverly selected illustrations in abundance. His system of teaching histology serves as a pattern, and his publications in this field include "A Course of Practical Histology", "Essentials of Histology" which has reached its thirteenth edition, and a "Text-Book of Microscopic Anatomy" which forms Part I of Vol 2 of "Quain's Anatomy", of which Sharpey-Schafer was one of the editors For his experimental classes he wrote a concise handbook, "Experimental Physiology".

Sharpey-Schafer was educated at Clewer House School and University College, London, where he gained several scholarships, including the first Sharpey scholarship. He served as assistant professor of physiology from 1874 until 1883 when Burdon-Sanderson was in charge, Sharpey the histologist having resigned in 1874 , in this year Sharpey-Schafer gained the M.R C.S Burdon-Sanderson was appointed to the chair of physiology at Oxford in 1883 and thus Sharpey-Schafer became Jodrell professor at University College, London, in the same year. He occupied this chair until 1899, when he was elected to the chair in the University of Edinburgh. This he retained until 1933, when on his retirement he had completed fifty years of service as a teacher of his science. Thus he came into contact with large numbers of students, scientific and medical, from all parts of the world During the same period he encouraged and trained many researchers and future professors of physiology. He kept an active interest in research right up to his retirement, and amongst his most recent work was an experiment on nerve function which involved an experimental section of a nerve in his arm. His researches brought him the fellowship of the Royal Society in 1878 when he was only twenty-eight years of age. The same society awarded him a Royal Medal in 1902 and its most coveted prize, the Copley Medal, in 1924.

Another field of research in which Sharpey-Schafer was actively engaged concerned the ductless glands and internal secretion. With Oliver he was a pioneer in the investigation of the function of the suprarenal glands. Swale Vincent, one of his assistants, also played a prominent part in the earlier researches on internal secretion and observed development of immunity to hormones. In this field Sharpey-Schafer occupied a leading position and published "The Endocrine Organs", originally founded upon a course of lectures, the Lane Medical Lectures, delivered at Stanford University, California, in the summer of 1913. The first edition of this book was published in 1916 and the second, Part I in 1924 and Part II in 1926. He introduced the term autacoid (ἀυτός, self and ἄκος, a medicinal agent) to include those drug-like substances produced by the organs of internal secretion for the purpose either of exciting or of restraining the activity of other organs, for the excitants he kept Starling's original term 'hormones' and for the restraining substances he introduced the term 'chalones'. His other researches and publications were very numerous and covered nearly the whole field of experimental physiology and histology. His early work on the minute structure of the fibre of the wing muscle of insects and his theory of muscular contraction attracted much attention. He also investigated ciliary and amœboid movement, the function of the spleen with the plethysmograph, fat absorption by the small intestine, localisation of function in the brain and the tracts of the spinal cord, during his earlier days, the study of pulmonary blood pressure, vagotomy and other nerve section covered later stages of his career.

Three publications deserve special mention, namely, the "Advanced Textbook of Physiology", Volume 1 in 1898 and Volume 2 in 1899, to which many of the leading physiologists—including Gaskell, Gotch, Leonard Hill, Gowland Hopkins, Langley, Burdon-Sanderson and Sherrington in Great Britain—contributed and of which Sharpey-Schafer was editor, also the "History of the Physiological Society 1876–1926"; he was the last of the original members and was elected an honorary member of this Society in 1930. Further, he founded the *Quarterly Journal of Experimental Physiology* in 1908 and edited it until his retirement in 1933. Volume 23, 1933, of this journal consisted entirely of original papers written by past and present assistants numbering twenty-nine and was dedicated to himself. He was presented with a bound copy of the volume containing an interleaf with their signatures; to obtain the signatures the interleaf had to travel to South Africa, New Zealand, Canada, America and China. On receipt of this bound volume on December 26, 1934, Sharpey-Schafer wrote: "I have now received the bound copy of the Honour Volume with the signature pages—which have gone round the world—bound in. It is a very handsome book, but I do not treasure it on that account, but for the pleasant memories it recalls." The *Quarterly Journal of Physiology* is now edited by a board of editors assisted by a number of collaborators, and in a foreword to Volume 24, the editorial board paid him the following tribute, that they will endeavour to continue the traditions and to maintain the level established by its founder, Sharpey-Schafer.

He took an active interest in the proceedings of the British Association for the Advancement of Science, serving as its secretary from 1895 until 1900. He was its president in 1912, and in his presidential address created a sensation by suggesting that early living matter had its origin in colloidal slime and that chemico-physical activity was sufficient to explain vital processes without the aid of any special vital force. He was knighted in the following year, 1913.

Sharpey-Schafer was an honorary fellow of numerous medical societies, and was LL.D. of the universities of Aberdeen 1897, McGill 1908, St. Andrews 1911 and Edinburgh 1933, also D.Sc. of Trinity College, Dublin 1905, Cambridge 1914, Melbourne 1914, Oxford 1926 and the National University of Ireland 1933; he was also M.D. of Berne 1910, Groningen 1914, D.Sci.Méd., Louvain 1930 and Hon. F.R.C.P. of Edinburgh 1931. He received also the Baly Medal of the Royal College of Physicians in 1897. In 1923 he was president of the International Physiological Congress and in 1933 president of the Royal Society, Edinburgh, receiving its Neill Medal in 1922.

Sharpey-Schafer's father was James William Henry Schäfer of Hamburg and Highgate. Sharpey-Schafer married twice, first in 1878, Maud eldest daughter of A. W. Dixey; she died in 1896. His second wife whom he married in 1900 is Ethel Maud, youngest daughter of J. H. Roberts, F.R.C.S. Lady Sharpey-Schafer survives him, as also does a daughter, Miss Sharpey-Schafer. He also had two sons, the eldest became a naval officer and the younger was a medical student at Cambridge when the War broke out. At this time, 1914, the elder son had retired from the Navy and was engaged in planting in Malaya. He left this for War service, at first in connexion with the harbour of Singapore and later with the Home Fleet, in the service of which he lost his life. The younger son joined up almost at once for service in France, was reported missing and lost his life very early in the War. The elder son had two sons, who survive their grandfather, one is a doctor on the medical staff of University College Hospital, and the younger is a lieutenant in the Navy.

While professor at the University of Edinburgh, Sharpey-Schafer resided at North Berwick, at first at 'Marly Knowe'—a fine home occupying a beautiful site on a small hill overlooking the west end of the town and the Firth of Forth. At this home during the summer term he and Lady Sharpey-Schafer graciously entertained members of his staff and numerous undergraduates, arranging all kinds of games from golf on the main links to bowls and tennis on their garden lawn. These functions were always greatly enjoyed by all under the kindly guidance of their esteemed professor and his charming lady. Among those associated with him in his early days in Edinburgh were the late T. H. Milroy (Belfast), John Malcolm (New Zealand), P. T. Herring (St. Andrews), the late Sutherland Simpson (New York), F. H. A. Marshall (Cambridge), John Tait (Montreal), Andrew Hunter (Glasgow), W. A. Jolly (Cape Town), H. Pringle (Dublin), J. Lockhead (Gibraltar) and W. Cramer (London). With these and other assistants he may be said to have founded the Schafer school of physiologists.

Sometimes when the Physiological Society met in Edinburgh, Sharpey-Schafer would complete the scientific business in the morning and then invite all the members to spend the afternoon with his family at 'Marly Knowe', North Berwick. During his later years he resided at 'Park End', North Berwick—a house on the foreshore of the Firth of Forth near the golf course. In 1933 he underwent an internal operation and withstood it exceedingly bravely but later developed pneumonia. He apparently recovered somewhat from these trials, and was able to go about again slowly and to entertain his friends with his usual mental acuteness. He resigned his chair in Edinburgh in 1933 and remained at 'Park End' but had intended, sooner or later, to move to the south of England to be nearer other members of his family. However, he never left North Berwick and died near the golf course and the Firth of Forth which he loved so much.

With such large numbers of students in his classes, few of them were able to know the man apart from official duty, and to some Sharpey Schafer appeared rather distant, but all his assistants and research workers were able to appreciate the kindly heart and goodwill which characterised their chief and benefactor. In 1922 his past and present assistants, co-workers and research pupils presented him with a portrait plaque and medal; the plaque we understand is now at University College, London. Most of his older students did not know him as Sharpey-Schafer but as Schäfer. He adopted the former name in 1918 to emphasise his indebtedness to Sharpey, who inspired his early work. It is impossible for an old assistant to express his feelings adequately for this great scientist and staunch friend.

J. A. C.

WE regret to announce the following deaths:

Mr. C. F. Cross, F.R.S., who was associated with the late Mr. E. J. Bevan in the viscose process for the production of artificial silk, on April 15, aged seventy-nine years.

Prof. W. R. Hodgkinson, formerly professor of chemistry and metallurgy at the Ordnance College, Woolwich, an authority on the chemistry of explosives, on April 8, aged eighty-three years.

Mr. H. R. Kempe, formerly principal technical officer and electrician to the Post Office, and author of the "Engineer's Year Book", on April 10, aged eighty-three years.

Dr. Albert Mann, of the U.S. National Museum, Washington, formerly professor of botany in the Ohio Wesleyan University (1895–1900) and in the George Washington University (1907–9), an authority on diatoms, on February 1, aged eighty-one years.

News and Views

The Sugar Beet Industry in Great Britain

THE United Kingdom Sugar Industry Inquiry Committee, the report of which (H.M.S.O. Cmd. 4871) was issued last week, failed to come to a unanimous conclusion on the fundamental issue of whether the beet sugar industry should be carried on with State assistance. The subsidy policy which was initiated in 1924 essentially as an experiment has already cost the Exchequer more than forty million pounds, and its extension for the present season will cost more than seven million pounds. Mr. Wilfred Greene, the chairman, and Sir Kenneth Lee, in their majority report, conclude that there is no reasonable prospect of the industry being permanently self-supporting. The principal value of the industry is as a relief measure to arable farming, but they consider the method extravagant and inequitable. Over the whole period of the subsidy, the cash payments to farmers have only just equalled the cost of assistance. The same acreage of beet could, in fact, have been, and still could be secured as cheaply by paying farmers to grow sugar beet and keep them on the farm for use as they thought fit. The majority is unable to recommend the continuance of State support beyond the maximum rate of duty preference grant to Colonial sugar, and it recognises that this would substantially mean the discontinuance of the beet sugar industry in Great Britain. Compensation to farmers is proposed for three years on an acreage basis.

IN the minority report, Mr. Cyril Lloyd emphasises the difficulties of forecasting the trend of future prices, and of giving precise values to the indirect benefits from the industry. National considerations of the difference between free trade and protectionist policies are, for him, of much greater importance than the contention that, biologically, sugar cane is more efficient than sugar beet for the production of sugar. He recommends continuing the assistance for a long-term period by a levy on all imported sugar. The reports agree on the broad principles of a reorganisation scheme, should it be decided to continue the industry. It is proposed to amalgamate the beet sugar interests, and to control the whole industry by a Permanent Sugar Commission. It is also agreed that any such scheme should provide for a programme of research and education on a scale very much larger than that which has existed up to the present. Valuable educational work has been done locally by the factories' agricultural staffs, county organisers and other educational and research institutes, and, since 1927, about £4,000 a year has been spent by the factories on a national programme of technical experiments and education, including a prize scheme for beet growers. In spite of the very large sums involved in assistance to the industry, no funds whatever have been made available by the State itself for research, and no fundamental research of any kind in sugar beet problems has been initiated.

Rivers Medal, 1934, and North African Studies

THE selection of Miss Gertrude Caton-Thompson for the award of the Rivers Memorial Medal for 1934 by the Council of the Royal Anthropological Institute will be cordially endorsed by all who follow the progress of archæological studies with any degree of close interest. The medal is awarded annually, and was founded to perpetuate the memory of the late Dr W. H. R. Rivers by recognising work of outstanding merit in any branch of anthropological studies. Miss Caton-Thompson's work as an excavator of archæological sites has covered a varied field in time and space. It has ranged from the earliest prehistoric period to the fringe of historic times in Egypt, the Libyan Desert and southern Africa. Her investigation of the Zimbabwe culture of Southern Rhodesia has not only pricked the bubble of speculation, but it has also based the solution of an obscure problem of African ethnology on an assured body of archæological fact. No one will question that Miss Caton-Thompson's work is "characterised by wide knowledge, sound judgment and insight", to quote the words of Dr H. S. Harrison in making the presentation of the medal at the meeting of the Royal Anthropological Institute on April 9, at which Miss Caton-Thompson delivered a lecture on the results of the Institute's archæological expedition to the oasis of El Kharga, of which she has been in charge. The importance of these investigations may be gauged from her examination of their bearing on some Stone Age problems of North Africa—problems which recent studies, especially by French archæologists, show to be assuming an increasing importance in the reconsideration of the prehistory of North Africa and its relation to the origin and development of the later palæolithic and mesolithic cultures of Europe. (See NATURE, 133, 107; 1934. 134, 975, 1934. 135. 550; 1935. An account of the investigation of the rock-shelter of Afalou in Algeria will appear shortly.)

MISS CATON-THOMPSON'S investigations of geological and archæological conditions at Kharga, which have extended over a period of three years, have fulfilled expectation in throwing much light on the succession of cultures in the early stone age of Egypt and the desert, and have provided material of crucial importance for the problem of early man in North Africa as a whole. They have demonstrated the inseparable relation of the distribution of early man to water supply throughout this region, even where no visible indications of water supply are associated with isolated finds in the desert conditions of to-day. Variation in the quantity and distribution of moisture in quaternary times, as indicated by an examination of the geological conditions at Kharga, affords a chronological criterion in determining the age and succession of stone age cultures. Miss Caton-Thompson indicated the significance of the mound springs in French North Africa, where an Upper Acheulean, with which nothing in Egypt is comparable, shows non-local peculiarities which link with Palestine. In comparing and contrasting the succession of cultures at Kharga from Acheuleo-Levalloisean to neolithic with that of adjacent regions, Miss Caton-Thompson pointed out that M. Vaufrey's views on the dating of the Capsian culture, if fully accepted, force a revision of ideas concerning Aurignacian origins in western Europe and Kenya, and a redating of desert pictographs. Certain gaps in the series might, she thought, be bridged by discoveries in the later Aterian series. On the whole, Miss Caton-Thompson's investigations in the later phases of the Kharga series would appear to support the most recent views of French archæologists on the weight to be given to local development and specialisation rather than to contact and movement.

F. W. Harmer (1835–1923)

APRIL 24, 1835, saw the birth of Frederic William Harmer, one of the pioneers in the field of East Anglian geology, and one of the last of the distinguished amateurs by whom the science was advanced so much during the Victorian era. Harmer came of an old Norfolk family, and by his public services was prominently identified with the city of Norwich. In his early years he had only scanty leisure to devote to geology, but a chance meeting with the younger Searles Wood was the beginning of a long-continued geological partnership. The map they prepared of the glacial deposits of Norfolk and Suffolk on a scale of 1 inch to the mile was the first 'drift' map of the kind in the world. After the publication of much valuable material on the Pleistocene deposits of the east of England, came Wood's death in 1884. For a time, Harmer devoted himself to municipal duties and the politics of the day, but some ten years later, when he might well have felt entitled to the leisure of life, he resumed an intensive study of the Tertiary and Quaternary geology of East Anglia and the Continent. A series of papers on the Crags, still standards for reference and highly esteemed, inaugurated a new regime in East Anglian geology; and his contributions to glaciology and palæo-meteorology were no less stimulating. Two outstanding productions of the eve of his life, each entailing immense labour, were the detailed map showing the types of boulder clay and trails of erratics in England and Wales, and the great monograph, published by the Palæontographical Society, on the Pliocene Mollusca. The latter work was an achievement which will long earn the gratitude of investigators, and will ever remain a fitting monument to his memory. An appreciation of Mr Harmer's scientific work appeared in NATURE for June 9, 1923 (p. 779). Sir Sidney Harmer, formerly director of the Natural History Departments, British Museum, is a son of Mr F. W. Harmer.

Franz Chvostek (1834–84)

THIS year marks the centenary of the birth of Franz Chvostek, one of the most eminent Austrian military doctors of the last century. The exact day and month of his birth are not ascertainable. He qualified in 1861, and for the next few years he served as a regimental medical officer. In 1868 he was appointed lecturer in electrotherapy at the

Joseph Academy in Vienna, where he succeeded Duchek as director of the medical clinic in 1871. He held that office until 1874 when he became head of a medical department in the Garrison Hospital, Vienna, and remained there until his death on November 16, 1884 His literary activity is shown by the fact that during the last twenty years of his life he published no less than 163 articles on various medical subjects. Although he specialised in electrotherapy, he published only six papers on the use and value of electricity in medicine, most of his writings being concerned with the pathology and treatment of diseases of the nervous system His name is attached to a sign consisting in the sudden spasm seen on tapping one side of the face

Excavations at Colchester

THE preliminary survey, anticipatory to complete publication, of the results of five years excavation on the Romano-British site at Colchester, which Mr Christopher Hawkes contributed to *The Times* of April 12, by bringing together the more significant of the details already reported in the accounts of current progress, gives a clearer conception than has previously been possible of the extent to which this investigation has added to our knowledge of conditions in south-eastern Britain immediately before, and in the early days of Roman conquest. The magnificent system of fortification which has been revealed, in its relation to the occupation site which it defends, bears eloquent testimony to the high degree of organisation and the social and political importance attained by this British town, while the character of the finds, especially the local factory of Samian ware, a feature without known parallel in Britain, indicates, on one side its importance as a centre of British culture, and on the other its standing as a point of close economic, and probably political, relation with the Continent Although it has been possible to follow the course of events on the area of British occupation and its history in later days in some detail, the position still remains somewhat obscure. It would appear as if still more important discoveries have yet to be made. Nothing that appeals as adequate to the dignity of this centre of the Belgic settlers has as yet been discovered. It is all the more important, therefore, that means should not be lacking to follow up the investigation before the commercial development of the area precludes further excavation. The appeal, of the Colchester Excavation Committee for further funds deserves, and should receive, generous support.

Unveiling of the Replica of the *Rocket* Locomotive

ON April 11, the Minister of Transport, Mr. L Hore-Belisha, unveiled the new replica of the *Rocket* which has just been added to the locomotive collection in the Science Museum, South Kensington. Mr. Hore-Belisha pointed out that the importance of the *Rocket* in the history of the locomotive lies in the fact that the chief features of its design had been followed down to the present day. He then referred to the precautions for the public safety which have been taken from the earliest days of the railway, so that the numerous regulations which govern the movement of traffic on rails are not regarded as restrictions, but as guarantees of efficiency and security Had similar foresight been shown in connexion with the motor-car, the nation might have been spared the material, economic and personal loss which the weekly casualty lists reveal We are now trying to make good rapidly the omissions of forty years. The measures we are now forced to institute, had they proceeded *pari passu* with the growth in the numbers of mechanically propelled vehicles on the road, would have been regarded as natural. Methods of road traffic control are being borrowed from the railway The *Rocket* demonstrated its capacity in a competition on the railway To-day, it would probably have been sent to the testing station at Vitry, in France, to enable its operation to be scientifically studied In the country which produced the *Rocket*, there is no similar testing station for locomotives, and Mr Hore-Belisha expressed the hope that the omission would be repaired

Liverpool Naturalists' Field Club

ON April 27 the Liverpool Naturalists' Field Club celebrates the seventy-fifth anniversary of its foundation by a field meeting at Rabymere, Cheshire, where its first meeting was held in 1860 The Club has been responsible for three floras of Liverpool, one the work of Mr. Robert Brown, who also wrote the botanical section to the British Association Liverpool Handbook, and the last two the works of Col C. T Green. Founded by the Rev H H Higgins (president 1862–93) and Dr Joseph Dickinson (president 1860–62) the Club has maintained an active and amiable co-operation between professional scientific workers and amateurs in all branches of field natural history, and at present has referees in botany (W. S. Laverock), micro-fungi (Dr C. T Green), aquaria (Fred Jefferies), lepidoptera (Mrs Makinson) and ornithology (Eric Hardy), the ornithological section having plans to form a local bird observatory or ringing station like that at Heligoland, as a mark of the anniversary. Some of the leading members in the Club's history were: Rev. H. H Higgins, who discovered 200 additions to the local flora in four years, and was author of works on the fungi, Diptera, flora and other subjects of the Liverpool district, and particularly the notable collection of fern fossils he discovered at Ravenhead, Lancashire, G H. Morton (president 1894), who delivered an address to the Club on the geology of Liverpool which the council published and which was later enlarged into his celebrated "Geology of Liverpool"; Col. J. W. Ellis (president 1899 and 1910) and Prof. Robert Newstead (president 1907–8), entomologists, and Dr. Joseph Dickinson, author of the second "Flora of Liverpool". Since its foundation, the Club has not failed to issue an annual proceedings of 40–50 pages, and at one time its members issued their own monthly journal, the *Liverpool Naturalists' Scrap Book*, followed by the *Liverpool Naturalists' Journal*. The honorary secretary is Mrs. W. S. Laverock, Millbank, Mill Lane, Wallasey.

Jersey Meeting of the British Empire Naturalists' Association

THE decision of the council of the British Empire Naturalists' Association to hold a summer holiday meeting at Jersey in the latter half of June is an interesting tribute to the natural history interests of the Channel Islands, where so many Continental and North African plants reach the northern limit of their distribution, and certain reptiles and birds unknown in England may be studied In its flora, Jersey holds most interest to the British naturalist for the very mild winters permitting up to forty species to flower in late December, thus producing a Continental rather than British flora The most interesting species on the island not found in the rest of the British Isles are the Jersey bugloss , the Jersey toadflax, one of the rarest of European flowers blooming at the end of May ; the Jersey star thistle , and the loose flowered orchid The region of St Ouens Bay is considered the richest botanically, for there are few woods on the island, though such rare flowers elsewhere in Britain as the wild daffodil flourish on the cliffs, maiden hair fern in certain rocks, wild wallflower on the walls of Mont Orgueil Castle, yellow horn poppy, golden samphire, sea-lavender and sea kale on the coast *Scirpus americanus*, found at St Ouen's Ponds, is a very rare rush of the Jersey flora, while the Jersey fern (*Gymnogramme leptophylla*, Des), a North African species, is equally interesting

FROM the point of view of marine zoology, Jersey offers invaluable opportunities to the visitor Frequent storms have revealed the stumps of submerged oak and alder forests in St Ouen's Bay, the Museum of the Societé Jersiaise possessing a photograph of some five hundred stumps visible on one occasion Of bird-life, the island is rich in sea-birds, and a young herring-gull ringed by the London Natural History Society at the colony at Point Grosnez on June 24, 1934, was recovered at St Nazair (Loire Inf), France, on November 1 The beautifully marked wall lizard is found on the island, though it does not occur in Britain except as an escaped pet. Similarly, the insect fauna is rich in Continental forms, particularly butterflies, seldom reaching England Geologically, Jersey resembles France, though in parts it may be likened to South Ireland, Devon and Cornwall The rocks are mostly granitic Jersey has the most varied rocks of the Channel Islands, presenting a mixture of metamorphic rocks, conglomerates, and sandstones with syenites and quartzites, while shale and blown sand are also prevalent Archæologically, the island is noteworthy, and its cromlechs have caused wide interest, especially the large one at Mount Orgueil. The president of the British Empire Naturalists' Association is Mr Douglas English The arrangements of the Jersey meeting are in the hands of the honorary secretary of the Jersey branch of the Association, Mr E. R. Casimir, Font Hill, Woodville Avenue, Jersey

Rationalisation in Industry and Technical Education

IN his presidential address to the Association of Technical Institutions at the annual general meeting on February 22 and 23, Brig -General Sir Harold Hartley discussed the question of how far the present trend of industrial development, and particularly the increasing size of industrial units, presents new problems in technical education Following the rapid progress of both pure and applied science under which co operative research has been initiated and the processes of the older industries subjected to scientific scrutiny, in addition to the development of entirely new industries, had come the beginnings of rationalisation The tendency to increase the size of industrial units and to operate on the principles of mass production involves scientific research for the analysis and control of each process While the disturbance produced by the War was a prime cause of the failure of these methods to raise the standard of living, misuse of opportunities afforded by research could intensify our difficulties The modern method of production creates a new series of problems involving the co-operation of a team of specialists, and this team work is the characteristic feature of large-scale management The smooth running of a large-scale unit depends on each of the components engaging intelligently in its task and performing this in proper co ordination with the rest

SIR HAROLD HARTLEY suggested that technical institutions can do something to assist those entering industry to understand their functions in relation to others, and in selecting individuals best suited for the various tasks The extent to which it is possible to give the student a general picture of the industry which he is to enter, its organisation and management, and its relation to other industries requires careful consideration The relation between the technical and commercial departments and the assistance which statistics afford to management are highly significant to-day, and Sir Harold Hartley urged greater emphasis on cost as opposed to efficiency in the discussion of processes and plant Finally, he emphasised the importance of a dynamic conception of industry and of co-operation both inside an industry in isolating and solving a problem, and between education and research The understanding between them must become closer and closer if we are to utilise fully the resources of Nature

The Droitwich Broadcasting Station

IN a paper read to the Institution of Electrical Engineers on April 11 by N Ashbridge, H Bishop and B N MacLarty, a description is given of the new radio broadcasting station at Droitwich in Worcestershire The station contains two transmitters each performing a separate function One transmitter works on a 'long' broadcasting wavelength in the band 1250–1875 metres and the other on a medium wave-length between 200 and 545 metres The long-wave transmitter has replaced Daventry 5XX, which worked with a power of about 25 kilowatts This station was the first broadcasting station in Europe to employ a power in excess of five kilowatts. The other transmitter replaces Daventry 5GB, which was first erected as an experimental transmitter, but afterwards gave the regional programme service to the Midlands. The present aim of the British Broadcasting Corporation is to supply every potential listener with a service of two distinct programmes. The distribution scheme which is now approaching completion will make one programme available to 98 per cent of the population and the other programme available to 85 per cent By virtue of the length of the wave on which it works, and its aerial power of 150 kilowatts, the new long-wave transmitter at Droitwich gives vastly greater possibilities of 'coverage' than any of the other transmitters in the country, all of which work on medium waves The other Droitwich transmitter covers the densely populated districts in the Midlands The Droitwich site was found to fulfil the requirements for a station of this type The subsoil in the immediate neighbourhood is favourable to the propagation of radio waves. Short high-grade telephone circuits connect it with the nearest studio headquarters It is suitable for building work, and there is plenty of space for the aerial system Lastly there is a trustworthy and ample water supply.

Value of Criticism

PROF. ERWIN SCHRÖDINGER, in an article entitled "Science, Art and Play" (*Philosopher*, 13, No 1), maintains that the present-day spirit which challenges all authority and allows nothing to be immune from criticism, manifests itself in the 'crisis' now existing in most of the sciences Science, at any rate research work, together with art and play, provides an outlet for that surplus store of energy which men usually have to spare after satisfying their primary needs It might be argued that science gives far greater practical benefits than art or play, or that the intellectual joy of the research worker is as nothing to the material value of the results obtained But the advances of applied science, as exemplified in greater facilities for travel and communication, give not only material benefits but also pleasure for their own sake Prof Schrödinger admits that science can rarely give direct joy to the community, but what matters is that the greatest possible number of people should have the opportunity of approach to intellectual pleasures It is not accidental that at the present moment the sciences are being forced to a complete reassessment of values, for the ideas forming the background of the individual sciences are connected with the ideas of the age, and the dominant spirit will accept nothing on authority. This should not be feared, for what is worth preserving preserves itself, and requires no protection.

The Citrus Industry in Jaffa

AN article in the *Fruit, Flower and Vegetable Trades' Journal* of February 16 describes "The Jaffa Citrus Industry". Oranges were introduced to Jaffa in the tenth century; they delighted the eyes of the Crusaders and their opponents. An Egyptian devastated the town and the surrounding country in the fourteenth century, and the orange groves were not re-established until the eighteenth century. Palestine exported nearly 1½ million boxes of oranges before the War; her export trade disappeared during the conflict, but now it has returned and increased. Jaffa is the chief exporter of grape fruit, and second only to Spain in export of oranges Forty-five per cent of the exportable crop is at present controlled by Jews and the rest by Arabs, but when present plantings mature, the Jews will control 65 per cent. The development of overseas markets is difficult, owing to the imposition of tariffs, and to the fact that Palestine is a mandated territory and can demand no reciprocity of trade The Government of Palestine has instituted an inspection service, has established a research station and has created a fund for propaganda Difficulties of transport from Jaffa to the port have still to be overcome, production promises to be increased threefold by 1938 The industry is launching a large scheme of advertisement, in an attempt to cope with this increase in output, and already the consumption of Jaffa oranges in England has increased considerably since the scheme was initiated

Land Utilisation Survey

THE fourth annual report, for 1934, of this Survey shows that great progress has been made Of the field work, only about ten per cent of the total area of Great Britain has still to be done The uncompleted areas are mainly in Sutherland, part of the Southern Uplands, the northern and eastern parts of the West Riding, central and southern Wales, and parts of Wiltshire and Cornwall. In preparation of the six-inch sheets for publication, which entails reduction to a one-inch scale, much progress has also been made Twelve sheets have been published, seven others are in the press and twenty more have been reduced Further progress has been delayed solely by lack of funds For many of the sheets published or in process of publication grants, guarantees or advance orders have been obtained, and the Survey is anxious to obtain further help of this kind The Survey is planning a series of handbooks to accompany the published sheets

Cultivation of Tomatoes

THE imposition of duties on imported tomatoes has naturally stimulated the production of this fruit in Great Britain, although the industry had already assumed large proportions. The home production under glass is estimated at more than 1,140,000 cwt., but even so, this only accounts for less than one third of the total home consumption, imports for 1932 amounting to as much as 2,442,000 cwt. Very considerable knowledge with regard to tomato growing has been obtained at the Cheshunt Research Station, and at the invitation of the Ministry of Agriculture, the director, Dr. Bewley, has prepared a bulletin on the subject which provides growers with a wealth of valuable information (Bull. No. 77, Tomatoes: Cultivation, Diseases and Pests. H.M. Stationery Office. 1*s*. 6*d*. net). Soil treatment before planting, manuring, optimum soil and air temperature during growth are among the aspects of the subject discussed in detail, while recommendations as to the choice of the best variety, methods of marketing and measures to be adopted for the control of diseases and pests are also supplied. In addition, the construction and heating of glasshouses are considered, and a detailed plan of a low pressure hot water heating apparatus is appended

Cambridge Philosophical Society

THE *Proceedings of the Cambridge Philosophical Society* now appears in a new and more convenient form The number of parts in a volume has been reduced from about seven to four, to be published at the ends of January, April, July and October, but the size of the page has been increased, and the general style and layout have been considerably modified so as to bring the journal more into line with the *Proceedings of the Royal Society* and the *London Mathematical Society* The first issue in this new form contains papers by Prof G H Hardy on "Fourier Kernels", Prof G N Watson on 'Ramanujan's Continued Fraction", and six other papers on pure mathematics As for mathematical physics, M. H L Pryce applies Born's new field theory to a simple special case, A Lees places a new interpretation on Dirac's linear wave equation, H A Bethe discusses the neutrino, and W W Sawyer deals with a point in the separation of heavy hydrogen. The experimental papers include experiments on neutrons by C. H Westcott and T Bjerge, and investigations of downcoming wireless waves by J L Pawsey We regret to notice that the Council has decided not to issue any more parts of the *Transactions* of the Society at present In the past it has contained many researches which were of great value, but too lengthy for the *Proceedings*

Population Growth and Birth-Control

RAPID increase of the population of India has led to a demand for the inception of preventive measures Birth-control there, and also in Great Britain, is, however, criticised by Col C A Gill in a recent somewhat polemical paper (*J Hygiene*, **34**, 502, 1934) According to Col Gill, population in an area ought to be considered not only from the point of view of numbers, but also from the occurrence of irregular changes or 'movements' in the population, which, apart from migration, are largely determined by forces controlling the birth- and death-rates Statistical methods forecasting future population ignore such 'movements' of population, and estimates based upon population-growth curves have proved unreliable, for example, in India, and must be accepted with reserve In a primitive community, prolificity as a means of race survival and an essential factor for progressive evolution is a paramount necessity, and artificial birth-control would constitute racial infanticide. Rural India, it is held, is such a community and is under-populated, and any State action to promote the practice of birth-control there is regarded as being a political crime and a biological blunder. In Great Britain, natural forces are now acting tending to limit increase of population, such as postponement of the average age of marriage and, possibly, a real decline in fertility. Since Nature requires a wide field of selection, nothing should be done to restrict the reservoir from which in the past many have sprung who have contributed greatly to human progress The encouragement of birth-control among the masses, it is argued, is therefore to be regarded as being biologically reprehensible

The Geographical Magazine

A NEW monthly publication has appeared entitled the *Geographical Magazine* (London · *Geographical Magazine*, Ltd , 1*s*) The first number fulfils the aim of the editor to depict the geographical background of important events, works of construction and conservation, and the conditions in which various peoples are living throughout the world Attention will be given also to exploration, travel in little-known lands and among primitive peoples, and the life of animals in relation to their environment The eight articles include accounts of Abyssinia by Major R E Cheesman, India's North-East Frontier by Capt Kingdon Ward, the routes in the North Syrian desert by Miss C P Grant, the aborigines of Central Australia by Mr B Macgraith, the "Changing Face of Amsterdam" by Mr F R Yerbury The home country is represented by an article on the Lake District by Mr Hugh Walpole and Prof P Abercrombie There are numerous and good illustrations and a small map is given with each article Half the profits made by the magazine are to be devoted to a fund for the promotion of geographical knowledge to be administered by a body of trustees under the chairmanship of the president of the Royal Geographical Society

World Survey

PUBLISHED under the auspices of the World Power Conference, a new monthly periodical entitled *World Survey* has appeared this month (5*s*. net), its aim being described as that of presenting and analysing world economic trends A special feature is the inclusion of a section recording, by means of index numbers, changes in industrial and agricultural production, wholesale and retail prices, unemployment, production of power and fuel and other statistics relating to transport, finance and world trade. In the first number, the articles cover a wide field, including among other subjects the future development of power-producing industries, the international aspects of public works, and machinery and labour displacement. In a special world economic service section, there are articles dealing with Belgium and the gold standard and with the world rubber situation. It is intended that *World Survey* shall facilitate an international exchange of information and opinion between those engaged in the power and fuel industries and economic experts, so that industrial data can be analysed and related continuously to theoretical work. An international bibliography of new publications relating to power and fuel is also included as a monthly feature

Science Abstracts

THE two volumes of *Science Abstracts* of 1934 have now been issued Each is 7–8 per cent smaller than the corresponding volume of 1933, but the decrease in the number of abstracts is in neither case so great The Physics volume has 1,561 pages, more than 300 of which are devoted to the subject index, the supplementary index of apparatus and instruments and the author index The Electrical Engineering volume has 905 pages, more than 150 of which are occupied by subject index and author index Each volume is indispensable to those who would keep themselves up to date in the field it covers

British Health Resorts

THE British Health Resorts Association has issued a new edition of its official handbook ("British Health Resorts Spa, Seaside, Inland (including New Zealand, South Africa, and Canada)" London J and A Churchill, Ltd 1*s*) The handbook is edited by Dr Fortescue Fox, and contains a foreword by the Minister of Health, Sir Hilton Young, and it is claimed that there is no other publication like it in Great Britain or any other country Authoritative information is given of every health resort in the British Empire, and some useful pages are devoted to winter health resorts in Great Britain The information concerning each resort includes an illustration, and details of climate, the diseases for which it is suitable, and particulars of attractions and accommodation

Announcements

SIR HENRY LYONS has been appointed member and chairman of the Advisory Council of the Science Museum in succession to Sir Richard Glazebrook, who has resigned

ACCORDING to *The Times* of April 12, Mr Martin Lindsay has been awarded the Alexandre de la Roquette Gold Medal by the French Geographical Society for his leadership of the British Trans-Greenland Expedition, 1934

PROF. EMIL ABDERHALDEN, director of the Physiological Institute at Halle, has been elected a foreign member of the Lombardy Society of Medicine, and a corresponding member of the Pontifical Academy of Sciences in Vatican City

THE Committee of the A Chauveau Foundation has recently awarded the prize in veterinary science to M. C Dubois, director of the veterinary services of Gard, for his work on undulant fever in animals

ON April 9, Lady Oppenheimer opened an interesting exhibition of books about trees, collected mainly by certain publishers, under the auspices of the society of "Men of the Trees", and displayed at its headquarters at 10 Victoria St , Westminster, S.W 1. In addition to modern books and pamphlets, many interesting old books have been gathered together, including a fourteenth century MS. of St. Isidore's "Etymologia", a kind of encyclopædia of all knowledge as it was known in the sixth and seventh centuries, including the properties and care of trees

THE Tomarkin Foundation is arranging the seventh International Medical Post-Graduate Congress, under the auspices of the University of Brussels, to be held at Brussels on September 12–19, and at Spa on September 20–October 2. The Congress is officially approved by the General Commissariat of the World Exhibition which will be held in Brussels at the same time. Further particulars can be obtained from the Secretary, Tomarkin Foundation, Faculty of Medicine, 97, rue aux Laines, Brussels

ON April 10, Sir John Gilmour, the Home Secretary, opened the new Metropolitan Police Laboratory for the scientific investigation of crime, which has been established at Hendon The members of the Committee which has been formed to advise on the development of the Laboratory are . Lord Atkin, Lord Dawson of Penn, Lord Trenchard, Sir Russell Scott (Permanent Under-Secretary of State, Home Office), Sir Edwin Deller (Principal of the University of London), Sir Bernard Spilsbury, Sir Frank Smith (Secretary, Department of Scientific and Industrial Research), Sir Robert Robertson (Government Chemist), and Mr Hugh Lett (senior surgeon to the London Hospital)

MESSRS BERNARD QUARITCH, LTD , 11 Grafton Street, W 1, have celebrated this year by issuing an extremely interesting list of five hundred rare and choice books (Cat 500) Among these is a number of early scientific and medical classics and rarities To the bibliophile, this catalogue with its bibliographical detail and its thirty illustrations will make a special appeal , and librarians and collectors with funds at their disposal will find many treasures here to tempt them. Prices range from 15*s* upwards, but it must be realised that this is emphatically not a bargain hunter's catalogue, since the average price of the books offered is nearly £100 each

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A research assistant to the British Cast Iron Research Association—The Director, 21 St Paul's Square, Birmingham, 3 (April 23) An assistant lecturer in building in the College of Technology, Manchester—The Registrar (May 3) An advisory economist in the Department of Agriculture, University of Leeds—The Registrar (May 7). A professor of obstetrics and gynæcology in the University of Hong Kong—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1. Two radio research assistants in the Research Laboratories, G.E.C., Ltd., Wembley, Middlesex—The Director.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 624

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Cosmic Rays from Nova Herculis?

THE appearance of a new star in the constellation of Hercules is of considerable interest not only for the astronomer but also for the physicist W Baade and F Zwicky[1] recently advanced tentatively the hypothesis that cosmic rays are produced in the outburst of super-novæ The few communications[2] on Nova Herculis do not show—so far as they are accessible to us—whether this new star can be classed as of the super-nova type The light emission shows an increase from the date of discovery (December 13) until December 25

W Kolhörster[3] has reported that his measurements between December 22 and 31, 1934, with a double coincidence Geiger-Muller counter indicated an increase of 1·7 per cent during the time when the nova was high above the horizon (9-16 M E T) He said that the detection of this effect by the ionisation method would be more difficult on account of the variations of the barometer effect and the directional uncertainties in ionisation methods Nevertheless, it seemed worth while to investigate if very accurate instruments like our Steinke standard apparatus showed any effect of the appearance of the nova

Two of our Steinke instruments were placed at 2,300 m above sea-level (Hafelekar Observatory), and a third apparatus of the same type stood in Innsbruck, under the roof of the University building (600 m above sea-level). They were kept at constant temperature (15° ± 0 2°) and were permanently screened from local radiations by lead shields of 10 cm. thickness underneath and on the sides. The hourly mean values of ionisation were reduced to the same barometric pressure.

First we compared the average intensities of a series of days before and after the appearance of Nova Herculis. This is necessary on account of the irregular variations of the cosmic radiation ('variations of the second kind'). The results are given in the following table together with the mean errors.

	Hafelekar (2,300 m)		Innsbruck (600 m)
	Instrument No 9 (no lead on top)	Instrument No 3 (surrounded by 10 cm lead)	Instrument No. 8 (surrounded by 10 cm. lead)
December 1–12 December 13–20 and 22	4 464 ± 0·008 J 4 465 ± 0 008 J	2 804 ± 0 004 J 2 807 ± 0·006 J	1 777 ± 0·002 J 1 787 ± 0·003 J
Effect of Nova	+ 0 001 ± 0 010 J	+ 0 003 ± 0 007 J	+ 0 010 ± 0 004 J

We see that a very small increase of ionisation is shown by all three instruments , this effect is, however, well within the limits of the mean errors, with the exception of No. 8, where the increase (0·010 J ± 10 mJ) is twice as great as the mean error If we take the average of the values from December 17 to December 20 (or 22) when the new star approached its maximum brightness, we obtain larger effects, which are (compared with the period December 1–12) + 13, + 10 and + 15 mJ, for No 9, 3 and 8 It must be kept in mind of course that even these effects are of the same order of magnitude as the mean errors

If the increase mentioned is really due to the new star, we should expect to get a relatively larger increase by taking average values not for whole days but for hours when the nova was high above the horizon In the week December 13 to December 20 the nova was at its maximum altitude practically at noon Now we must take into account that, at this time of the day, a maximum of the ionisation has been found to occur[4] A possible effect of the nova naturally would be superposed on this solar noon maximum which, on the Hafelekar, exceeds the night minimum by about + 10 mJ Therefore in order to separate these effects we must compare the difference of ionisation at noon and at night before and after the appearance of the new star

This was done by grouping our observations in three different ways as shown below

Difference of Day and Night Ionisation (in mJ) before and after appearance of Nova Herculis.

	Instrument No 9		Instrument No 3		Instrument No 8	
	Nov 22–Dec. 12	Dec 13–Dec 20	Nov 22–Dec 12	Dec 13–Dec 20	Nov 22–Dec 12	Dec 13–Dec 22
(a) Comparison of mean values 9^h–15^h and 21^h–8^h	+ 18	+ 18	+ 4	+ 11	+ 1	+ 2
(b) Comparison of mean values, 11^h–13^h and 21^h–3^h	+ 19	+ 13	+ 6	+ 9	0	0
(c) Comparison of mean values, 10^h–14^h and 22^h–2^h	+ 17	+ 13	+ 6	+ 6	+ 4	+ 2

The noon maximum is well marked in nearly all cases. An increase of the day-night difference after the appearance of the nova is clearly discernible only in three cases (No 3 *a* and *b*, No 8 *a*) Apparatus No 9 on the Hafelekar, which would also show effects of softer radiations, does not indicate any positive effect of the nova Instrument No 3 shows a slight positive effect in (*a*) and (*b*) Instrument No. 8 (standing in Innsbruck, only 600 metres above sea-level) does not show any decisive effect It must be remembered, though, that all these difference effects whether positive or negative are again within the limits of the possible mean errors, and that these are larger here where the mean values taken were not for the whole day.

It is very unfortunate that our measurements had to be discontinued on December 22, so that no measurements at the time of the maximum brightness of the nova were available. Therefore our results are not quite comparable with those of Kolhörster

From the foregoing results, we can only conclude that it was not possible to prove an effect by the ionisation method in the period December 13–22 due to the appearance of Nova Herculis There are indications of a small increase of ionisation after the appearance of the nova, when mean values of whole days before and after December 13 are taken The effect, if it is real, certainly does not exceed 2 per thousand of the total radiation and does not exceed the limits of the mean errors

VICTOR F HESS
RUDOLF STEINMAURER
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der Universität, Innsbruck
Feb 22

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[1] W Baade and F Zwicky, *Proc Nat Acad Sci*, **20**, 254, 1934

[2] NATURE, **135**, 193, Feb 8, 1935 Also K Graff, *Zirkular der Mittelmeerstation der Wiener Universitaetssternwarte*, Nr 1, 1935

[3] W Kolhörster, *Z Phys*, **93**, 429, Jan 1935

[4] V F Hess, R Steinmaurer and H Graziadei, *Wien Sitz Ber*, IIa, **143**, 313, 1934

IN the period July 1934 March 1935, we have registered the intensity of the cosmic radiation with a coincidence apparatus, kept the whole time in the same position The counters were arranged with their horizontal axes vertically one above the other, so that the 'field' of the apparatus was 400 square degrees Nova Herculis was in the field of the apparatus from 16^h10^m until 20^h0^m sidereal time (all time references are to mean sidereal time), in culmination it showed an angle of 1° 38′ 50″ towards the south with the vertical line joining the axes of the counters

The accompanying table contains the experimental data, col. I indicates the mean number of coincidences per hour, while the Nova was in the field of the apparatus ($16^h30^m-19^h30^m$), col II gives similar data during other hours of the day; col III gives the difference between I and II as a percentage of II We give the values for the months August, September, October, that is, before the flaring-up of the Nova, and for November, December and January separately. The data for December are repeated in the third row, because that was the time when the greatest changes were occurring in the luminosity of the star; on November 14 it was a star of magnitude 14, while on December 23 it had reached magnitude 1·5. In the fourth row are the data for February, when 36 cm of lead was placed between the counters

	I $16^h30^m-19^h30^m$	II $20^h30^m-15^h30^m$	III $\frac{I-II}{II}100$
Aug, Sept, Oct	22·69 ± 0·28	22·04 ± 0·11	2·95 ± 1·36%
Nov, Dec, Jan	30·41 ± 0·35	30·83 ± 0·14	0·26 ± 1·24%
December	31·21 ± 0·61	30·54 ± 0·24	2·19 ± 2·15%
February (36 cm lead)	18·97 ± 0·51	19·01 ± 0·20	−0·21 ± 2·88%

The data show that the intensity increase during the time of culmination of the Nova does not exceed in any case four times the mean error, and even twice the mean error is reached only in the means of August, September, October, before the outburst of the Nova

We can infer from the foregoing that the effect of undeflected or, in comparison with the field of the apparatus, not essentially deflected cosmic rays, coming from Nova Herculis is not appreciable—in any event, not appreciable beside the oscillations due to other effects such as diurnal variation.

Judging our results from December in a most unfavourable manner by assuming that the error of measurement may be as great as three times the mean error, we can conclude that the intensity of cosmic rays coming from Nova Herculis is even in that case only twenty times as great as the intensity observed from an average surface of 1 square degree of the sky Astronomically speaking, if we employ the ratio between the average starlight per square degree and the magnitude of the stars, we conclude that the cosmic ray magnitude of Nova Herculis can in no case exceed $1·6^m$

The apparatus was constructed with the assistance of the Széchenyi Scientific Society

J BARNÓTHY
M FORRÓ
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March 13

A Method of Measuring the Collisional Frequency of Electrons in the Ionosphere

I READ Mr Eckersley's interesting letter[1] concerning the measurement of the collisional frequency of electrons in Region F of the ionosphere, but feel very doubtful whether, as he says, his measurements refer to Region F_1 It seems to me that they must refer to Region F_2, the highest and most densely ionised level of the ionosphere At the time of his measurements (1605 on October 1, 1934), other observations, carried out at the Radio Research Station of the National Physical Laboratory, show that the extraordinary ray critical frequency for Region F_1 was 4·2 mc/sec which is different from the value of 5 mc/sec indicated by Mr Eckersley. Moreover, since the ionisation in Region F_1 exhibits a most regular type of seasonal and diurnal variation, with no abnormalities, it does not seem possible to account for the discrepancy as a local effect observed only at Chelmsford. It must also be pointed out that the formula previously given in a discussion of long-delay echoes for the ionospheric reflection coefficient, used by Mr Eckersley, is an approximate one and its use in connexion with this particular problem does not seem justifiable For the ordinary ray reflection coefficient ρ we have, more accurately,

$$\log \rho = -\frac{\nu}{2c}(P' - P) \quad \ldots \ldots \quad (1)$$

where P' and P are respectively the group and optical paths of the waves, ν is the electron collisional frequency and c the velocity of light. Since Mr. Eckersley's measurements yield values of P' only, he has neglected entirely the value of P in the above formula, although it is known that P' and P are of the same order of magnitude.

It may therefore be of interest that there is a rigorous method of applying (1) in which the neglect of an important term is avoided. Suppose we make measurements of ρ and P' for two wireless frequencies f_1 and f_2, we have from (1):

$$f_1 \log \rho_1 - f_2 \log \rho_2 = \frac{\nu}{2c}\left[f_2 (P'_2 - P_2) - f_1 (P'_1 - P_1)\right] \qquad (2)$$

Also we have, generally,

$$P_2 f_2 - P_1 f_1 = \int_{f_1}^{f_2} P' \, df \,, \qquad (3)$$

so that, with a little reduction, there is obtained

$$\frac{\nu}{2c} = \frac{f_1 \log \rho_1 - f_2 \log \rho_2}{\text{area } X} \,, \qquad (4)$$

where the area X is shown in Fig. 1 on the usual (P', f) diagram. From (4)

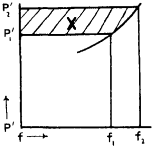

FIG 1

ν can be calculated In differential notation (4) may also be written

$$\frac{\nu}{2c} = \frac{1}{f} \frac{\delta(f \log \rho)}{\delta P'} \qquad (5)$$

A further point of interest is that when ν has been found in this way, the value of P, the optical path, may be estimated for any frequency with the aid of (1)

E V APPLETON

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April 4

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[1] NATURE, 135, 435, March 16, 1935

Ramsay and Helium

A STORY is current in scientific circles which relates to the discovery of helium. It is said that after listening to the lecture on the discovery of argon at the meeting of the Royal Society on January 31, 1895, Mr. H. A Miers (Sir Henry Miers) wrote to Ramsay, directing his attention to Hillebrand's discovery that minerals of the uraninite group gave off nitrogen, when heated with acids The story continues to the effect that Ramsay, being a very energetic man, at once went out and bought up all the clévite that was available, treated the mineral with acid, and got off a gas which proved to be helium. The story is told without malice, and, no doubt, would have amused Ramsay, but, unfortunately, it is true neither of the man nor of the period. The true story is characteristic of both

Ramsay certainly received the letter from Mr. Miers on Friday, February 1, but as he writes in his notebook, he spent that day, and also the following Saturday and Sunday, in revising and typing the paper for the Royal Society The next note in the notebook is "Didn't do much till Friday 15th", when he made and fitted up his first Töpler pump. Actually he had a lot of time to put in at the College, making up arrears of teaching work Then he carried out some additional determinations on the density of argon, purifying the gas specially for the purpose, the results appearing as an addendum to the argon paper This completed one piece of work

Ramsay next turned his attention to some experiments on the direct determination of the specific heat of argon, designed to answer criticisms put forward in the discussion at the Royal Society on January 31 The apparatus was made in the first week in March, and the first experiment was carried out on March 9 About this time his assistant, Mr Donald Matthews, carried out the first experiment on clévite Ramsay noted on March 20 "Matthews had obtained from clévite, about a gram of which I bought from Gregory (88, Fitzroy Square) for 3/6, a quantity of gas by boiling with dilute sulphuric acid". However, this work had been completed during the previous week, for there is a note, later "Crookes got the first lot (Saturday, March 16) but was too busy to examine it all the week" A preliminary examination had, however, been made, for on March 17 Ramsay had written to his friend, Mr Buchanan . "Crookes thinks that the spectrum is new, and I don't see how it can be anything old, except argon, and that it certainly is not We are making some more of it, and in a few days I hope that we shall have enough of it to do a density " The original 3*s* 6*d* worth of clévite had been used up, and a further quantity was purchased

In the meantime, Ramsay continued the experiments on the specific heat of argon, but as no communication was received from Crookes, on the morning of Saturday, March 23, he borrowed a second induction coil and proceeded to compare the spectrum of the new gas, 'crypton', with that of argon "While observing Crookes telegraphed—Crypton is helium, 58749 Come and see it Went and saw it"—so runs the record.

The current story does not accord with the spirit of the man, who could work with amazing rapidity, but who would settle one problem to his own satisfaction before proceeding to the next Nor is it in accord with the spirit of an age, in which the scramble for priority was rather less obvious than at present

A note on the discovery was written the same afternoon and communicated to the meeting of the Royal Society on the following Thursday In those days the Royal Society assumed that the news of a discovery by one of its fellows should first be announced at one of its meetings, if the Society were in session; and in the year 1898 the fact that the discovery of krypton had been communicated simultaneously to the Royal Society and to the Paris Academy, and had become public through the latter body, evoked indignant comments at the meeting at which our paper was read By relinquishing its prerogative the Society has lost a good deal

In a dramatised version of the discovery of helium the departure from fact might be justified, but as a matter of mere history the true story is possibly the more interesting

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March 15.

Early Man in South Africa

I WOULD be glad to be allowed to point out that Dr Leakey's results in Kenya are very closely similar to those found by me on the south coast of Africa—the quartzite area—except in the matter of time.

Leakey's Kanjera skulls are, as stated by Sir Arthur Keith, definitely negroid, in fact to judge merely by his fragments, very closely similar indeed to the man responsible for the Early Mossel Bay industry—of whom I now have three adult (one described by Keith[1]) and one juvenile skulls, that described by Keith, with its boat-shaped frontal region, being very aberrant in this respect This Early Mossel Bay (without a doubt much earlier than the Still Bay and its associated Fish Hock skull) is found in natural strata in the Grey Zone at the base of the Superficial Black layer[2] (also recently found much more numerously in the same zone at Plettenberg Bay by me), and this Black layer, representing present climatic conditions, must be taken to be Holocene

This prehistoric South African (or Kanjera man), however, was not only Holocene In 1934–35 I found sufficient fragments of a Late Stellenbosch skull in a shelter at Plettenberg Bay to convince anyone seeing them that they represent the very same type of man These Late Stellenbosch implements are extremely common in the Red Sand below the Black layer (see also ref 2), that is, in a deposit representing an arid period before the Holocene

If we now assume that the Middle Stellenbosch, at least, is due to the same human race, we at last come to the prehistoric South African more or less contemporaneous with Leakey's Kanjera man Here then we have perfect harmony between South and East Africa, except that Leakey, dealing with massive deposits from large volumes of water, may perhaps be overestimating the age of these deposits

If we now proceed to the lydianite area of the Free State, we find other resemblances—again excepting in the matter of time. A beautifully preserved series of deposits of a streamlet, each carrying implements, is to be seen at Bayswater, Bloemfontein. At a single spot, the following succession is preserved, the whole being more than twenty feet in thickness —

(1) Gravelly blue clay, blue clay, unconformity, representing a period of erosion (drought) during which the recently laid down strata were eroded away.

(2) Red boulder gravel, red grit, red clay, calcareous clay (only preserved towards the downstream end), black clay (only a small piece preserved at the extreme downstream end of the exposure), unconformity.

(3) Red boulder gravel, red grit, red clay, unconformity (at this spot the expected calcareous clay and black clay were completely eroded away)

(4) Reddish sand with its top heavily impregnated with lime—unconformity.

(5) Black layer At this exposure the Layer 3 forms a little hillock so that the Layer 5 has been mostly eroded away.

To my mind, this series can only mean one thing—that the strata represent the remains of five climatic cycles—the same number represented by the sand and peat layers twenty-four miles away at Floris Bad; and from Layer 1 to Layer 4 the lydianite culture was evolving in the same way as is to be seen at the Floris Bad and other sites. It, like the quartzite Stellenbosch, commences as a Clacton-like phase, with large Stellenbosch-like implements in dolerite, but the use of dolerite is almost at once abandoned (except for the production of large horse-hoof shaped cleavers—which are found through all the phases of the culture) and the lydianite flakes pass through Mousterian-like, Aurignacian-like and Magdalenian-like phases, all the phases continuing to be associated with extinct species of mammals The curious point about this evolution of the lydianite culture is that all its phases, especially the earlier ones, remind one (and Mr Van Riet Lowe agrees with me here) of Leakey's Early Kenyan Aurignacian

The early history of South Africa is not therefore as Leakey describes it for Kenya (with a Mousterian-Aurignacian technique following on a Chellean-Acheulean), not as it has been expressed in the accepted classification of South African stone implements, not as it used to be described for Europe—but as Breuil now accepts it for Europe, namely, with a contemporaneous evolution of the Chellean-Acheulean and a Clacton-Mousterian technique The only difference is that, in Europe, one can see no reason for this difference, whereas in South Africa the difference in the available material would to some extent explain it

It is not only in the stratification of natural deposits, and in the mammalian fossils of these, that the extreme age of the lydianite Clacton-Mousterian, as compared with the Late Stellenbosch, is to be seen, but also in the nature of the human remains The latter is associated with Kanjera man (better prehistoric South Africans), the former with the huge, very primitive ancestral form of *H sapiens*[3], which, it may be said in passing, has no points of resemblance, except in size, with the extremely dubious Rhodesian man

T F DREYER

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Feb 25

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[1] *Roy Soc S Africa*, **21**, Pt ii

[2] Dreyer, *Roy Soc S Africa*, **22**, Pt iii

[3] "Floris Bad Man", Dreyer and Ariens Kappers, *Kon Akad Amsterdam*, 1935

Distribution of Nuclear Mechanical Moments

AT present, the nuclear mechanical spins of about fifty atoms, including about sixty isotopes, are known. Of these, the spins of fifty-three odd atomic weight isotopes are known with a fair degree of certainty, some doubt existing only in very few cases. Two types of odd atomic weight atoms exist, namely, those with odd atomic number (*A*) and those with even atomic number (*B*) The former possess an odd nuclear proton, the latter an odd nuclear neutron. Amongst the fifty-three fairly reliable spins, thirty-nine belong to the former class and fourteen to the latter. The distributions of the nuclear mechanical moments in the two classes are shown in Fig 1

The difference in the distributions is very striking. No significance is probably to be attached to the missing $\frac{7}{2}$ spin atoms in the lower curve, for as yet only a little more than half of all the atoms of the Periodic Table have been studied. In spite of this, the above distributions appear to have real significance Thus although class *B* atoms are only one-third as numerous as class *A*, yet there are more spins of $\frac{1}{2}$ in class *B* than in class *A*, and this can scarcely be accidental in view of the general trends of both the curves.

The curves must be bound up with considerations of the building up and stability of atomic nuclei It is apparent that high values for nuclear moments are very improbable in class *B* atoms, and class *A* atoms tend to show that $\frac{3}{2}$ and $\frac{5}{2}$ are very stable values when there is an odd nuclear proton Tamm and Altschuler[1] have shown that class *B* atoms sometimes have three neutrons contributing to the total nuclear moment, their spins totalling $\frac{3}{2}$ This spin then combines with an orbital moment to give the total nuclear mechanical moment of the atom The lower curve shows that the addition *in parallel* of the neutron spins with higher orbital moments is very improbable The combination in parallel with a higher orbital moment is obviously still less probable when only one nuclear neutron contributes to the spin.

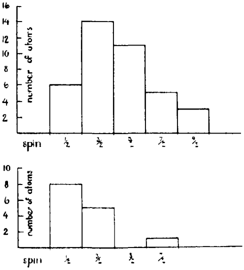

FIG 1 Distribution of nuclear mechanical moments of odd atomic number atoms (above) and even atomic number atoms (below)

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Feb. 20

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[1] Tamm and Altschuler, *C R Acad Sci U R S S*, **1**, 455, 1934

The Minimum Kinetic Mechanism of Photosynthesis

KINETICS of photosynthesis recently proposed in these columns[1,2,3] fail to account for all temperature coefficients observed, for demonstrable reversibility of the carbon dioxide – chlorophyll complex, and for known or deducible characteristics of the Blackman reaction. The following kinetic mechanism of photosynthesis, supported in every detail elsewhere[4], is proposed as representing the *minimum* number of photochemical and thermal reactions needed to cover the several major facts now established for many chlorophyllous plants in connexion with the following variables: temperature *T*, light intensity *L*, concentration of carbon dioxide (CO_2), amount of chlorophyll per unit volume (Chl), concentration of internal Blackman reaction component (*E*), and specific and indifferent narcotics, intermittent illumination, fluorescence[5] and induction[6]

$$\begin{array}{llcll}
\text{dark} & & \text{Chl} + CO_2 \underset{k_2e^{-Q_2/RT}}{\overset{k_1e^{-Q_1/RT}}{\rightleftharpoons}} \textit{Complex} & & \text{(I)} \\
\text{light} & & \textit{Complex} \underset{k_4e\ Q_4/RT}{\overset{k_3L}{\rightleftharpoons}} \textit{Complex} & & \text{(II)} \\
\text{dark} & \text{Blackman reaction} \left\{ \begin{array}{l} \\ \\ \end{array} \right. & \textit{Complex} + E \underset{k_6e^{-Q_6/RT}}{\overset{k_5e^{-Q_5/RT}}{\rightleftharpoons}} \textit{Complex-E} & & \text{(III)} \\
\text{dark} & & \textit{Complex-E} \xrightarrow{k_7e^{-Q_7/RT}} \text{Chl} + E + \text{Product} & & \text{(IV)}
\end{array}$$

Photosynthesis is a cyclic process consisting of at least four *experimentally recognisable* forward reactions, besides incidental physical diffusion of carbon dioxide The scheme given indicates the velocity constants, orders and sequence of the four reactions, and contingent equilibria and steady states The Blackman reaction occurs *after* the light reaction with respect to a given molecule of carbon dioxide, and involves only combined, not free chlorophyll, and no free carbon dioxide (contrary to mechanisms of Emerson and Green[2] and Conant, Dietz and Kamerling[7] It consists observably[4] of *two consecutive* reactions The first is second order and possibly appreciably reversible, the second is first order and irreversible The over-all Blackman reaction varies experimentally from *apparent first order to zero order*, *E* reckoned as catalyst The order decreases as the ratio (*Complex-E*)/(E_{total}) increases with (Chl_{total}) (HCN), (CO_2), *L*, 1/*T*, 1/(indifferent narcotic) and growth conditions Chlorophyll does not act as a simple photosensitiser It first forms some complex with the substrate carbon dioxide, or a derivative thereof, possibly aqueous, *prior* to the light reaction (not provided by mechanism of Kautsky and Hirsch[9]) Although not always equilibrated, the complex is freely and *measurably reversible*[8] (not provided by kinetics of Baly and Morgan[1] or Emerson and Green[2]) Oxygen appears as product in (IV), but present data do not decide as to elimination of carbohydrate in (I), (III) or (IV), (I) may require an additional reducing component if perchance carbon dioxide is reduced thermally by a mechanism similar to that in chemo-autotropic bacteria prior to the light reaction

Kinetics derived for the complete mechanism yield an inconvenient quadratic in *y*, the steady state rate of photosynthesis in the absence of limiting carbon dioxide diffusion However, the reverse reaction in (II) is normally negligible[9], whence[4,8]

$$y = \frac{k_1k_3L(CO_2)\,(\text{Chl}_{\text{total}})}{Dk_3k_1L(CO_2) + k_1(CO_2) + k_3Le^{Q_1/RT} + k_2e^{(Q_1-Q_2)/RT}} \quad (A)$$

where *D*, temperature sensitive, is

$$(E)k_5k_7e^{-(Q_5+Q_7)/RT}/((E)k_5e^{-Q_5/RT} + k_6e^{-Q_6/RT} + k_7e^{-Q_7/RT})$$

When the Blackman reaction is apparently first order ($(E) \sim (E_{\text{total}})$), equation *A* is explicit in *y*, and provides, in accordance with experiment, for hyperbolic relations[8] between *y* and (CO_2), and *y* and *L*; for temperature coefficients independent of ($\text{Chl}_{\text{total}}$): and for strict linearity of log *y* in 1/*T* *only* when any one term in the denominator in equation (A) exclusively dominates, except conditionally the first term. y is temperature sensitive at high L and high (CO_2) due to D; at high L and low (CO_2) due to Q_1; at low L and low (CO_2) only if $Q_1 - Q_2$ is appreciable, and is temperature insensitive at low L and high (CO_2) Q_1 and D appear to vary from organism to organism, and differently, so that the temperature coefficient is sometimes a function of (CO_2) (contrary to conclusion of Baly[3]). The dissociation constant in (I) is about 5×10^{-5} M CO_2 for most plants, and the heat of reaction $(Q_1 - Q_2)$ zero in *Chlorella pyrenoidosa* Specific narcotics normally effect (III)–(IV), indifferent narcotics mostly (I)

Suggestive in connexion with future experimentation, comprehensive but conservative, fairly rigid but capable of flexible, consistent extension, this 'minimum' mechanism may be harmonised, for common points considered, with the well known mechanisms of Willstätter and Stoll, Warburg and Uyesugi, James, van den Honert, Muller, and Emerson and Arnold[9]

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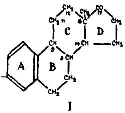
[1] Baly and Morgan, NATURE, **133**, 414, 1934
[2] Emerson and Green, NATURE, **134**, 289, 1934
[3] Baly, NATURE, **134**, 933, 1934
[4] Submitted to *J Amer Chem Soc*
[5] Kautsky and Hirsch, *Biochem Z*, **274**, 422, 1934
[6] Van der Pauuw, *Rec Trav bot néerl*, **29**, 497, 1932
[7] *Science*, **73**, 208, 1931
[8] Lineweaver and Burk, *J Amer Chem Soc*, **56**, 658, 1934
[9] *J Gen Physiol*, **15**, 391, 1932

Chemistry of Œstrogenetic Substances

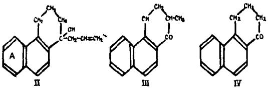
IN œstrin (I) the carbonyl group in 17 is connected with the aromatic ring A through the carbon atoms 13, 12, 11, 9 and through the atoms 13, 14, 8, 9



I

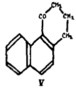
The four carbon atoms 13, 14, 8, 9 are the four centres of asymmetry of œstrin At the same time, they form the junctions between rings B and C (8, 9) and C and D (13, 14) The orientation in the space of the whole œstrin molecule therefore is due to the arrangement of the four carbon atoms 13, 14, 8, 9

It is remarkable that, in order to induce œstrogenetic activity, it is not necessary to connect the carbonyl group with the aromatic ring through four carbon atoms orientated in a definite way. A connexion through two carbon atoms is sufficient to produce distinct, although weak, œstrogenetic activity This result can be deduced from the work of Blum and Bergmann[1] and Cook, Dodds and Hewett[2] These authors investigated some hydrogenated phenanthrene compounds In the work of Blum and Bergmann, 1-oxy-1-allyl-1 2 3.4-tetrahydrophenanthrene (II) and 1-keto-2-methyl-1.2 3 4-tetrahydrophenanthrene (III) were active Cook, Dodds and Hewett got œstrus production with 1-keto-1.2 3.4-tetrahydrophenanthrene (IV), whilst 4-keto 1 2.3.4-tetrahydrophenanthrene (V) was completely inactive :



II III IV

ACTIVE



V

INACTIVE

The formulæ II–V compared with œstrin demonstrate that, in order to produce œstrus, the carbonyl group (III, IV) or the corresponding alcoholic group (II) must be connected with ring A through two carbon atoms, as in II, III and IV, whilst the connexion through one carbon atom as in V is insufficient

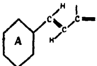
Rings B and C of œstrin are connected in the *trans* position, since œstrin is a flat molecule, a flat molecule being possible only if the connexion is of this type This fact, combined with the results obtained with hydrogenated phenanthrene derivatives, suggested the question as to whether rings B and C are necessary for the synthesis of substances having œstrogenetic properties, and if not, whether fatty-aromatic compounds, in which a carbonyl group is connected with an aromatic ring through two carbon atoms in the *trans* position would to be œstrogenetic

Substances fulfilling these conditions are easily available Aromatic aldehydes, combined with pyruvic acid by caustic soda, give unsaturated α-ketonic acids of the general formula (VI)

$$R - CH = CH - CO - COOH$$

VI

Their connexion with the problem under investigation is shown by the following formulation (VII).



VII

The sodium salts of these unsaturated α ketonic acids can easily be prepared in high purity, as I have shown recently[3,4], and it was found that the aldehydes and pyruvic acid are condensed in these compounds in the *trans* position (M Reimer[5], E. Friedmann[6]). So far as tested, unsaturated α-ketonic acids, injected into spayed mice, produce œstrus of the same order as 1-keto-1.2.3 4-tetrahydrophenanthrene

This result can be developed further. Even the aromatic ring, corresponding to ring A of œstrin, is not necessary for the development of the œstrogenetic effect, as the benzene nucleus can be replaced by the furane ring, fural-pyruvic acid (IX) being even more active than benzal-pyruvic acid (VIII):

$C_6H_5-CH=CH-CO-COOH$ VIII $\qquad$ $C_4H_3O-CH=CH-CO-COOH$ IX

Recent experiments suggest the possibility of getting œstrogenetic activity in ring-free compounds by arranging the carbon atoms 13, 14, 8, 9 of œstrin in a suitable way Work is in progress to see whether these results can be confirmed by the capon-plumage test.

The application of the views developed above for the preparation of cancer producing substances can easily be seen Investigations in this direction have been started

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[1] O Blum, E Bergmann, *Naturwiss*, **21**, 578, 1933
[2] J W Cook, E C Dodds, C L Hewett, NATURE, **131**, 56, 1933
[3] E Friedmann, *Helv Chim Acta*, **14**, 783, 1931
[4] E Friedmann and H Mai, *Helv Chim Acta*, **14**, 1213, 1931
[5] M Reimer, *J Amer Chem Soc*, **48**, 2454, 1926

A Gyroscopic Top which will Walk Down Steps

IN his book on "Gyrostatics and Rotational Motion", the late Prof Andrew Gray explained how a top can be made to move along two parallel horizontal wires when they are rocked so as to change the point of support from one wire to the other A few years ago, I discovered that a spinning top will automatically walk down two parallel wires arranged as an inclined plane

While working with high speed motors, it occurred to me that a rapidly spinning top would have a very slow precession and could be made to walk down two wires bent so as to form a succession of steps The top and steps are shown in Fig. 1

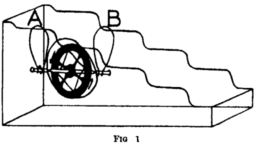

FIG 1

My assistant, Mr Fullmer, who built the top, found that the length of the steps and the height of the risers must be very accurately proportioned to the type of top used. The steps should not form a sharp corner with the risers, but must be curved at each junction.

The top is spun at four to five thousand revolutions per minute and held with one hook in the middle of the highest step while the hook on the opposite side is pressed against the second highest riser (see points *A* and *B* in Fig. 1) The top, when released, will walk down the steps.

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Infra-Red Photography of Coal

IN a letter in NATURE of February 2 (p 265) Prof J. Walton has remarked that infra-red photography of thin sections of coal should give interesting results We would like to direct attention to some results of work on this subject

We should mention first that there are already some references to this topic in the literature of coal petrography—for example, Klingner[1], Boddy[2], and Wandless and Macrae[3] The last-mentioned paper includes a few illustrations of infra red photographs of coal sections made by one of the present writers

Besides these examples, however, several hundred other photomicrographs have been taken in this laboratory, and the infra-red plate has proved more generally useful than the panchromatic Our experience of the two types of plates enables us to make the following generalisations concerning their use in this class of work

(1) The principal advantage of the infra red plate will be better understood if we first consider briefly the special photographic problems presented by coal sections These sections consist of heterogeneous mixtures of substances of the following colours white (empty spaces), brilliant yellow (spores and cuticles), and a continuous series of shades from pale red through deep red to black (vitrain, fusain, etc) Obviously it is extremely difficult to make realistic pictures of such objects in black and white, no matter what photographic plate is used In order to obtain detail in any one of these colours, detail in others must necessarily be sacrificed

Panchromatic plates, even when the developing and printing process is adjusted to give a 'soft' effect, generally give prints which suggest that the colour transition between pale red and black is less gradual than is actually the case In infra-red photographs, however, this defect is considerably reduced, hence they generally produce much more realistic pictures

(2) There are special cases in which the panchromatic is still to be preferred to the infra red plate; for example, photographs of cell structure in vitrain In such cases, there may be no yellows and whites to be depicted, the entire field consisting of reds, so, contrary to the usual rule, 'contrasty' prints may be required

(3) Infra-red plates show another advantage over panchromatics for this work The field appears to be flattened

(4) Our laboratory methods for infra red photography involve the use of the Ilford infra-red plate in conjunction with the deep red filter specified by the plate-makers, and a light source sufficiently intense to enable the image to be focused by eye Using a weaker light and focusing by computation has not proved a success

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[1] *Montanistische Rundschau*, **26**, 1, 1934
[2] Eleventh Annual Report, Safety in Mines Research Board, p 16, 1932
[3] *Fuel in Science and Practice*, **13**, 4, 1934

Philosophical Interpretation of Science

IN reviews and articles that have appeared over the name of Prof. Dingle in NATURE, a particular philosophical point of view has been presented as if it were one to which scientific men must necessarily subscribe In his review of Eddington's "New Pathways in Science" in NATURE of March 23, p 451, for example, it is again explicitly stated, and although I am at one with him in many of his criticisms of that book, I am certain I speak not for myself alone when I dissent strongly from Dingle's philosophical outlook on science "We start with experience," he says, "pick out those elements which are common to all observers, represent them by concepts defined in such a way that they relate together as many as possible of the common experiences, and the resulting logical network is the 'external world' "

Now this viewpoint is put forward as if it were a necessary consequence of scientific discovery , indeed we are informed that relativity has saved the man of science from being "forced to admit an external objective world of which his experience was only one aspect" May I suggest that very many men of science assert that science is the result of man's interference in and study of the external world, and that without the latter there would be no science and no men , that they regard the statement that the *logical network* constitutes the *external world* as a fantastic misuse of terms , that when Prof Dingle says "We start with experience" he means "I [H D] start my analysis . . ", that when he talks of "all observers" he is either assuming an external world of which these observers are part or he is still talking of *his* experiences, and he has simply given the rather misleading title of "all observers" to them , that when he uses the English language in writing the review, either he is again using words evolved during the history of an external world and writing them for people all of whom are part of that external world, neither of which has been created out of Prof Dingle's *logical network*, or alternatively *his* mind has built this language and these people out of his experiences , that in the latter event the whole of science, art, literature and philosophy become the organised experience of Prof Dingle himself Does all this not look as if Prof Dingle is trying to pull himself up by his own bootlaces ?

Finally, since it is certainly true that a great number of scientific men of philosophical understanding would not accept Prof Dingle's interpretation (itself surely an experience), is he not compelled on his own criteria as to what constitutes the external world to refuse to accord his philosophy any status in that world ?

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Points from Foregoing Letters

BY pointing his cosmic ray detectors to Nova Herculis, W Kolhorster observed between December 22 and 31 an increase of 1 7 per cent in the amount of cosmic rays and brought this as evidence that cosmic rays are produced during stellar outbursts Prof V F Hess and Dr R Steinmaurer now give figures obtained by a different method showing that in the period December 13 22 a small increase in ionisation due to cosmic rays was recorded (less than 0 2 per cent), an amount within the limits of experimental error Mr J Barnóthy and Mr M Forró, from continuous records with an instrument similar to that of Kolhorster, conclude that cosmic rays coming direct from Nova Herculis were not an appreciable factor in the variations observed during the month of December

Prof E V Appleton gives a new formula for calculating the frequency of collisions between electrons and molecules in the upper atmosphere He points out that the earlier equation recently used by Mr T L Eckersley left out an important factor (the optical path) and that Mr Eckersley's measurements probably refer to the uppermost F_2 region, at about 300 km

The antiquity of the human remains found by Dr Leakey in Kenya has recently been questioned Prof T. F Dreyer directs attention to three adult and one juvenile skull found in South Africa These are closely similar to the Kanjera finds and are considered by Prof Dreyer to be of Holocene (post Pleistocene or recent) age , indirect evidence, from implements, indicates that the South African and Kanjera men already existed in pre-Holocene times Prof Dreyer further believes that the two types of implements (Chellean Acheulean and Mousterian) usually considered to belong to two successive periods (lower and middle Palæolithic respectively) were in fact evolved contemporaneously

The 'spin' of the atomic nuclei is an important factor in determining the probability of disintegration during atomic collisions Dr S Tolansky discusses the relation between the nuclear mechanical moments (due to spin) and the constitution of the nuclei He infers that spin values of 3/2 and 5/2 lead to, or are associated with, greater stability when an odd nuclear proton is present in atoms of odd atomic weight and even atomic number

Three stages have been postulated in the process by which green plants combine the carbon dioxide of the air with water to form carbohydrates Dr D Burk and Mr H Lineweaver claim that at least four reactions can be experimentally recognised They submit a formula showing how temperature, light, concentration of carbon dioxide and of chlorophyll, etc , affect the rate of these reactions

The chemical structure of the female sex hormone, œstrin, and of related synthetic chemical compounds with similar properties, is discussed by Mr E Friedmann He concludes that molecules with œstrogenetic activity, so far prepared, contain the carbonyl (CO) or hydroxyl (OH) group, connected through two carbon atoms with a benzene or other 'ring' , other combinations may also be active

Mr J J Walker and Dr L Slater discuss the application of infra-red photography to the examination of thin sections of coal In their opinion the method is useful in giving a more accurate reproduction of the colour transition between pale red and black, and in producing a 'flatter field' Under certain conditions, however, the panchromatic is still to be preferred to the infra-red photographic plate

Research Items

Dating by Beads at Zimbabwe. A study of beads in Africa south of the Zambezi by Mr. P. W. Laidler (*Proc. Rhodesia Sci. Assoc.*, **34**, pt. 1) aims at a classification of beads, ancient and modern, now or formerly in use among the natives. They are divided into ten classes, which are examined in relation, according to chronological considerations, with the stone structure culture of Rhodesia, thus incidentally raising the question of the tenability of Miss G. Caton-Thompson's dating of the Zimbabwe and associated cultures upon the basis of this class of evidence. Viewing the historical evidence, it would appear that no finds have been made which point to contact between South Africa and early Egypt. The Arabs landed trade beads on the East African coast previously to A.D. 1400, but it is impossible to say how much earlier, though Al Masoudi suggests that it was not long before A.D. 900. Before A.D. 1500, sites will show Indian beads only; after that date European beads appear in increasing proportion. The Rhodesian excavations show three groups, of which Group I is judged to be pre-Zimbabwe, but there is little or nothing to distinguish it from Group II, which was regarded by Miss Caton-Thompson as belonging to a later occupation. Group I, showing beads with Indian affinities, was regarded by her as a "foundation deposit", pointing to an eighth or ninth century date for the Zimbabwe type of building. This ignores in this assemblage of beads one example which is probably of late origin and does not fit in with the historical record. It is more probable that it is a 'pre-Zimbabwe' deposit. Miss Caton-Thompson's dating leaves Class II of the second occupation period with an intervening gap of six hundred years, whereas there is evidence to show that there is continuity of importation as between Class I and II. If Group I is, in fact, related to a pre-Zimbabwe culture, it is probable that the foundation date is much later than is suggested by Miss Caton-Thompson.

Cultural Origins, Monte Alban, Mexico. It is now practically agreed among archæologists, according to a communication circulated by Science Service, Washington, that the remarkable collection of ornaments of gold and precious or semi-precious stone, which were found in burials on Monte Alban by the Mexican expedition under Dr. Alfonso Caso in 1932, belong to an intrusive culture. Four seasons of intensive explorations have produced evidence of structures of a type found elsewhere in Mexico, and going back to a date believed to be contemporary with the Mayan Old Empire culture of Guatemala and Chiapas; but there is nothing to suggest any relation with the treasure find. More than seventy tombs have been explored, but no metal has been found. Recent excavation points to the civilisation of Monte Alban having flourished in A.D. 300–500, and it would appear possible that it may have been the point of origin of features, architectural and other, which appear on other sites of ancient Mexico. Among these is the cross-shaped tomb. An examination of the Dancers' Pyramid, so called from its carved dancing figures, has shown that its interior is a simple stone tomb, rectangular in shape, but with large niches on either side which are virtually the arms of a cross. This appears to be the germ of the idea which blossomed into the huge, mosaic-covered, cross-shaped tomb of Mitla, the site which stands some twenty miles away. When the tomb of the Dancers' Pyramid was opened, it was found to contain the skeletons of several individuals in complete disorder. Among these scattered remains were five human teeth which had been inlaid with jade, while others were incrusted with hæmatite. The pyramid also had three temple bases with sloping stone sides and jutting wall panels. These are found in other parts of Mexico, but nowhere of an earlier date.

Man-Eating Sharks. A paper by Gilbert Whitley upon Australian shark tragedies shows that not only are attacks frequent, but also they have been increasing in number during the last few decades (*Victorian Naturalist*, Jan. 1935, p. 195). During the present century, whereas the number of records of attack traced in the ten years from 1912–21 was 13, the number between 1922 and 1931 was 45 and in the three years 1932–34, 16. The increase is probably associated with the more extensive use of shallow waters for bathing. In New South Wales, which yields more than forty records or more than half the Australian total, the greater number of shark attacks were made during the months December to April, and this coincides with the most popular bathing season. No attack occurred between May and September, although in May and June boats have been bumped or attacked. The only safe means of combatting this danger is the building of nets, fences or other enclosures for swimmers. On isolated beaches, observations from aeroplanes or from shark towers are said to have proved useful.

Pairing and Non-Disjunction of Sex Chromosomes in *Drosophila*. In *Drosophila* females with XXY as sex chromosomes, there have been two views as to how synapsis takes place. It is agreed that they synapse in pairs and not in a triad, but Bridges suggested that there is an equal chance of any two of these chromosomes pairing, while Anderson concluded that pairing and crossing over between the X's is independent of the presence of the Y. Gershenson (*J. Genet.*, **30**, No. 1) has obtained further evidence regarding the nature of the pairing and non-disjunction in XXY females by using so-called ClB stock in which one of the X's has a large inverted section, which reduces crossing-over in females heterozygous for the ClB chromosome to a very low value. He found that the percentage of cross-over X-chromosomes is the same in the gametes of XX females and XXY females in this stock, indicating that synapsis is regularly between the two X's, while the Y goes later to either pole independently. In females having the composition $XX - ClB$, it is found that about 99 per cent of the eggs produced have a non cross-over X. Comparison of this frequency with the frequency of non-disjunction indicates that the mechanism of non-disjunction is similar in males and females of *Drosophila*, and is contrary to the hypothesis that regular chromosome pairing and disjunction depends upon chiasma formation.

Excretion of Glucose by the Rabbit Kidney. At a meeting of the Royal Irish Academy held on January 28, T. Dillon and R. O'Donnell described the excretion of glucose by the rabbit kidney. The threshold for the excretion of glucose by the kidney was defined as that blood plasma concentration (C_B) above which glucose is concentrated in the urine. Glucose was found to be present in the urine below threshold level, the concentration increasing with the urine rate. Considering the distribution of the threshold values in the experimental animal, the mode of the distribution was 230 mgm. per cent, but an individual value may lie in the range 180–420. The threshold level was increased by intravenous injections of sulphate and urea, but remained unchanged after chloride injection. It behaved therefore in an analogous manner to the chloride threshold as determined by Conway. The important quality of the threshold as above defined is that it is independent of the rate of urine flow. The excretion of glucose below the threshold value may be expressed by the equation $K = A\sqrt{(V/T - C_B)}$ where T = threshold, V = urine volume in c.c.'s per minute, and $A = (C_B - C_u)/C_B$, which is closely analogous to the equation derived by Conway for the diffusion of iodine from chloroform to potassium iodide solutions perfused over it, and also to the excretion of chloride below the threshold value. The value of K has a coefficient of variation for the individual result of 26, but this variation is independent of the variables used in equation. Above the threshold, glucose excretion is expressed by the equation $K_2 = \sqrt{V}(C_u - C_B)/(C_B - T)$. The results in this region are obscured by the concomitant high chloride excretion. They indicate that glucose and chloride excretion are dealt with by the same kidney mechanism. In both cases the 'diffusion-secretion' theory as established by Conway alone accounts for the observed relationships.

Hepatics of Southern Japan. Y. Horikawa has made an important contribution to bryology entitled "Monographia Hepaticarum Australi-Japonicarum" (*J. Sci. Hiroshima Univ.*, B, Div. 2 (Botany). Tokyo: Maruzen Co., Ltd. 2.10 yen). Southern Japan is one of the least-explored regions of the world for the hepaticologist; high mountains (up to 3,962 m.), primeval forest and numerous streams are favourable for a rich and abundant hepatic flora. Reports by Stephani (1899–1924) and Okamura (1915–16) record 57 species; this number is reduced to 43, and the author collates later scattered records, including his own discoveries, based on the study of 5,000 gatherings made by himself in twelve visits covering seventy-one days (1930–34). Three hundred and one species, eighty-four genera, twenty-one families and four orders are credited to the region, of which one genus and one hundred and seven species are new to science. The text is in English with diagnoses in Latin; there is a list of Japanese names; the extensive field work and the care given to descriptive matter, illustrations, synonomy,, etc., command attention. The conclusion is drawn from phytogeographical data that a land connexion lasted longer on the Japan proper side than on the South China side; the first separation came from the Formosan Channel and later erosion led to the successive separation of the islands of the Liukiu archipelago. Endemism is strongly marked. In the hepatic flora there is an almost total absence of Philippine elements. The presence of many boreal elements proves a former glacial epoch.

Early Daffodil Blooms. An article by Dr. J. Grainger (*Gardeners' Chron.*, March 9, 1935) outlines the principles underlying the production of precocious blooms from daffodil bulbs. The period between mid-November and Christmas is usually characterised by a paucity of decorative flowers, and the process described in the article should help to bridge this gap. The young flower of a daffodil is normally formed during the period between lifting in June, until the end of August. A rest period then sets in, and usually lasts about six weeks. The period of flower bud formation can be hastened by about three weeks if the bulb is kept at a warm temperature (75° F.), whilst the rest period is shortened by storage in an ice-box, at a temperature of 40°–45° F. Planting is performed immediately after the low temperature treatment, and the application of suitable growth temperatures results in the production of blooms as early as November 25. The hastening of flower bud formation is the treatment already known as 'preparation' by bulb growers, but in the paper under review, emphasis is laid on the additional need for low temperatures to shorten the rest period.

Antiquarian Study of Fungi. A short paper by Messrs. G. W. Hendry and H. N. Hansen in *Phytopathology* (24, No. 11, 1313–1314, November, 1934) records a novel method of studying the fungi of bygone times. The church building of the Mission Nuestra Senora De La Soledad was erected in the Salinas valley of California in 1793–94, and was rebuilt in 1832, from adobe or sun-dried bricks. Wheat straw had been used to bind the clay of which these bricks were made, and it has been found possible to identify remains of *Triticum compactum humboldtii*, Koke in bricks from the ruins. The straw also bore evidence of fungal attack, and *Puccinia graminis* and *Ustilago tritici* have been identified. These two fungi must have been present in California in 1832, and it is perhaps rather significant that the earliest mycological survey of California (that of Harkness and Moore in 1880) records *P. graminis*, but makes no mention of *U. tritici*.

Weed Killers. It has been said that agriculture is a 'controversy with weeds', and weed plants are certainly obstacles to the directive ecology of the gardener. Dr. M. A. H. Tincker has recently reviewed different types of weed-killers (*J. Roy. Hort. Soc.*, 60, Part 2, pp. 68–79, February 1935). The article deals mainly with chemical methods, although biological means of control are also mentioned. Common salt, petrol, ammonium and ferrous sulphates, carbolic acid, creosote, arsenic compounds, chlorates of sodium and calcium, sulphuric acid, copper sulphate, calcium cyanamide and ammonium thiocyanate are all useful for special purposes, though it would seem that the ideal weed destroyer has still to be discovered. Chlorates are regarded as the most practical weed killers, in spite of the danger of fire. Biological methods of control include the provision of vigorous 'smother crops', and the distribution of specific insect pests of weeds. Insects are sometimes too discriminating, however, as happened when the cochineal insect was used to control the prickly-pear cactus; it attacked only one species, *Opuntia monocantha*, and further methods had to be used to effect complete eradication.

Coal of the Upper Beeston Seam in West Yorks. Pub. No. 35, Physical and Chemical Survey of the National Coal Resources, issued by the Fuel Research Station of the Department of Scientific and Industrial Research (London: H.M. Stationery Office) constitutes Part 1 on the Upper Beeston seam, a highly important seam in this coalfield, which extends through the Yorkshire, Nottinghamshire and Derbyshire coalfields, forming one complete unit extending continuously for nearly seventy miles in a southerly direction from Leeds. It is stated that "For convenience the field has long been arbitrarily divided into three areas, Nottinghamshire and Derbyshire, South Yorkshire, and West Yorkshire. The present report deals with the northernmost of these, the West Yorkshire area." The Upper Beeston seam has been the most widely worked in the above area since 1917. A characteristic of this seam consists in a very dull durain, which is a particularly good and clean coal, but hard and usually spoken of as 'hard bands'. A large number of samples have been analysed, and the position of these is indicated on a map forming the frontispiece of this volume. Upon that map the area of the seam is divided into five parts, in each of which the Upper Beeston seam exhibits a characteristic thickness and structural development; the thicknesses vary from 2 ft. 6 in. to 4 ft. 6 in., the latter containing the dull bands of durain at their maximum development. The volume contains a large number of detailed analyses, in which the durain, vitrain, clarain and fusain have been analysed separately, whilst in many cases the calorific power was also determined separately. The coal is typically banded throughout, and is shown to contain a number of bands and partings, which in some cases divide the seam into an Upper and Lower part. Where this is the case, the Upper part alone appears to be worked.

Study of Earthquakes in California. Several articles have recently appeared on the study of earthquakes in southern California. Mr. H. O. Wood, to whom we are indebted for the plan of investigation, has described its details and the work carried on in the Seismological Laboratory at Pasadena ("Yearbook of the Carnegie Institution of Washington", 1934, 2347–2353). Dr. B. Gutenberg has given a full account of this building and its valuable instruments (*Ergebnisse der kosmischen Physik*, 2, 213–237; 1934). Auxiliary stations have also been founded at Riverside, La Jolla, Santa Barbara and Mount Wilson, and at Haiwee and Tinemaha in the Owens Valley, the scene of the great earthquake of 1872. In 1922, Mr. Wood published a map of all the known faults in southern California. Soon afterwards, the Wood-Anderson torsion seismometer was devised, and this has proved most useful in the study of local earthquakes. More than 200 epicentral tracts have been determined. In most of them, less than a dozen shocks have originated, in others some scores or hundreds, and, in a few, thousands of after-shocks of strong local earthquakes. It is interesting to notice that, with one or two exceptions, these epicentral tracts do not cluster along known faults, and that very few of them are connected with the well-known San Andreas fault along which the earthquake of 1906 originated. Indeed, the section of this fault between Tejon Pass and Cajon Pass, the seat of the great earthquake of 1857, was almost completely inactive during the six years before 1933.

The Upper Atmosphere. In a paper entitled "Some Facts and Theories about the Upper Atmosphere" by C. K. M. Douglas (*Quart. J. Met. Soc.*, 61, No. 258) various observations of pressure and temperature made in recent years in the upper atmosphere with the aid of specially equipped aeroplanes in different parts of Europe are discussed, with special reference to the light that they throw upon the mechanism of anticyclones and cyclones. During the year 1932–33, in which many countries co-operated in a special study of the meteorological conditions of polar regions, the so-called Polar Year, a Dutch expedition went to Reykjavik, and upper air data were extended temporarily to Iceland. These furnished a good opportunity for studying the changes in a given air mass in the course of one or two days while the air was travelling from Iceland to places in western Europe, where further observations aloft allowed its condition at the end of that journey to be ascertained. It was found that the change of temperature of a given air mass for a given height between 2 km. and 5 km. was often slow, but that rapid rises of temperature, up to 10° F. in 24 hours, occasionally took place, apparently as a result of the sinking of initially cold air to a lower level, which resulted in dynamical warming. Air which has been warmed in that way may often be identified by its very low relative humidity. The author came to regard subsidence of rather less than 1 km. a day as an average in an anticyclone that is developing in cold air of polar origin. He showed that the air ascending over a rain area is generally warmer than the adjacent air at a height of 4 km. Discussing the variations in the height of the tropopause, he comes strongly to the opinion that the air masses just above and below the tropopause move slowly up or down together. The parts played by various air movements in the life history of anticyclones and depressions are discussed.

Synchronous Time Motors and Accurate Time-keeping. A valuable property in connexion with alternating current motors of the 'synchronous' type is that they keep exactly in step with the frequency of the supply. With the advent of the national grid system in Great Britain, which eventually will give time-controlled frequency throughout the whole area, the synchronous motor enables a very satisfactory method of accurate time-keeping to be obtained. A paper on this subject by W. Holmes and E. Grundy was read on March 1 to the Institution of Electrical Engineers. The frequency of the supply given by many authorities is time-controlled, and the close relation it bears to standard time is very remarkable. Records of the error of a large supply undertaking connected with the grid show that the average errors from the standard time during the day varied between two seconds fast and one second slow. Continuity of supply has been observed independently in Cheshire, Lancashire and Yorkshire at private residences having synchronous clocks of the hand starting time. The interruptions occurred about once a year and varied in duration between a few seconds and a few hours. Considering that the tiny little motor rotates at a very high speed and receives no attention this is excellent. These motors are rapidly being applied for other purposes wherever accurate time-indicating is required. In the time switches used in electric supply they are rapidly superseding the spring driven clock movement generally used. It obviates the necessity for periodical winding and so is economical to supply authorities. For laboratory purposes an electric stop watch has been produced embodying a synchronous motor. When used on time-controlled frequencies, it will measure short intervals of time with an accuracy up to the twentieth of a second.

Biology and the Nation in Germany

THE administrative appreciation of the biological outlook in national development is nowhere so evident to day as in Germany and Soviet Russia A brief account of the current exhibition in Berlin on "Das Wunder des Lebens", which crystallises the use and abuse of biology by the third Reich, may therefore have some general interest The policy on which it is based was outlined by Dr Frick, Reichsminister of the Interior, in his inaugural speech on March 23 Unlike the 'liberalistisch marxistichen' regime, he said, National Socialism views the individual as an inseparable part of the family, and the family as the basis of the nation The individual therefore has increased duties to the State, but receives in return more rights, more protection, and the immediate promise of a happier and healthier life, secured through education, eugenic legislation and social assistance by the State It is significant that he did not take a narrow national view of these activities Indeed, he hoped that the Exhibition would be regarded as a renewed token of international friendship, and expressed the belief that the German people are anxious to work in a spirit of amiable co operation not only for themselves but also for the growth of a healthy Europe

Conceived in this spirit, the Exhibition is presented with a freshness and technical excellence which one expects from the organisation behind it—the Deutsches Hygiene Museum at Dresden It is also noteworthy that it makes no demand on the State budget, advertisers providing the cost and visitors an anticipated profit Two halls concerned with 'Bekleidung-Schmuck' and 'Ernährung' are entirely devoted to products which not only harmonise with the motif of the Exhibition, but also supplement the technical halls in a most attractive manner The first and most interesting of these scientific halls deals with 'Die Lehre vom Lebens', and is approached through an impressive 'Ehrenhalle' dominated by a monumental relief (*Empor*) symbolising the release of the German people under the new administration Among the exhibits, the place of honour is given to 'The Transparent Man', a model under automatic electrical control which illuminates and explains each system of the body in turn It is a masterpiece of museum technique, enshrined in a darkened chamber in which these words of Augustinus are prominently inscribed

> "Es bewundern die Menschen das rauschende Meer,
> Die fliessenden Gewässer und den Anblick des
> Himmels,
> Und vergessen uber allem Bewundern der Dinge
> Das Wunder, das sie selber sind "

In the main body of this hall, working models and striking diagrams demonstrate the elements of anatomy and physiology in relation to personal and public health A lattice tower, for example, shows that the daily energy involved in the mechanism of the heart could take two persons to the top of the 'Funkturm' (138 metres high) adjoining the Exhibition Nearby a large wire cage illustrates the average volume of air (32 cubic metres) required by a man in one day, while neighbouring exhibits indicate respiratory needs during various activities and postures, and the relation between the respiratory and circulatory systems A square relief conspicuous on the ceiling represents the surface area of the normal number of red blood corpuscles in man Among the working models, of particular interest are those concerned with the circulation of the blood, the importance of water, the processes of digestion and the time taken to digest various foods, the mechanism and causes of dreams, the cerebral area involved in different actions, the location of bodily pains and the possible diseases they indicate, the functions of the ductless glands and their correlation with abnormalities, and the discrimination of 'basic smells', which visitors may experience for themselves A small cinema shows biological films ranging from cellular activities to the intelligence of monkeys, while a section for 'Biologische-Leistungsprufungen' encourages visitors to test their own lung capacity, vocal range, cardiac normality and colour vision

From this hall one passes over an attractive 'Terrasse Restauration', with a symbolic fountain, to that which deals with 'Der Trager des Lebens' An ante-chamber, decorated with impressive reliefs and diagrams of vital statistics in Europe, emphasises the importance attached to a large population of working-class families in the new Germany In the centre, a 'Glockenturm' rings out the information that nine children are born in Germany every five minutes, while at the base of the structure a huge hour glass records the death of seven persons during the same period Two quotations from the Chancellor's "Mein Kampf" illustrate the spirit in which this hall is conceived One is the familiar ' Honour the work and honour the worker", while the other sermonises more voluminously as follows: "Auch die Ehe kann nicht Selbstwert sein, sondern muss dem einen grosseren Ziele, der Vermehrung und Erhaltung der Art und Rasse, dienen" To the right of this chamber is a nursery where the children of visitors can rest and play

Passing into the main hall, one is confronted with an imposing illuminated exhibit, dominated by the national emblem, showing that National Socialism endeavours to protect every aspect of family life from childhood to old age Freely translated, the words written over the eagle state that "The hereditary healthy family is the basis of life The maintenance of their ability to work, and their protection and education in self-help, is therefore one of the great tasks of the NSDAP" And the most confirmed opponent of dictatorship must admit that the new party has attacked that task with commendable energy. One sees in this hall the results of a determined effort for the betterment of the family, through such avenues as education and care of mothers and children, the training of the average girl for her share in the development of the State, and poor-relief measures extending from the provision of food clothes and coal to travelling schools and clinics which tour the districts The central organisation for these activities, which cover the entire country is the *NS-Volkswohlfahrt*, the funds of which are largely obtained from voluntary subscriptions, stre collections from the sale of badges made by the rural workers, and so on In the winter a special effort i made, its success being partly indicated by the fa that nearly 360 million marks were contributed t 'Winterhilfswerk' in the winter of 1933–34. Th monthly 'Eintopfgericht' Sunday alone, when a majority of the population contributes to 'winter-help' the savings resulting from restricting the mid-day meal to one dish, provided more than 25 million marks.

The next hall, 'Die Erhaltung des Lebens', illustrates the protection of public health in all its aspects, and the visitor can see in it many of the latest devices of preventive and curative medicine, ranging from occupational therapy and radium treatment to the latest Junkers 'Sanitätsflugzeuges'. The sanitary and educational activities of the Nazi party are also amply illustrated. A feature of the hall is a model marriage consultation centre, to which attention is attracted by illuminated curves, correlated with pictures of social conditions, of the birth- and death-rates since 1820. They show that the birth rate rose from 1820 until 1875, and fell in response to increasing industrialisation between 1875 and 1933, when it again assumed an upward trend. The inclination of the death-rate follows, as usual, that of the birth rate. The elevation of the birth-rate in the new regime has been secured not only by propaganda but also by State aid, 20 marks a month being given for each child in families of more than three children, provided they are 'racially healthy'. It should be added that these consultation centres will increase in importance, for further measures for the betterment of national health are to be introduced very shortly, including legislation for health certificates before marriage.

Special attention is also paid to racial 'purity', Gobineau being given an important niche in the portrait gallery of great men who have influenced the Nazi philosophy. In one popular section the Nordic farmer and fighter is glorified in pictures reminiscent of juvenile editions of the "Nibelungensage", surmounted by the statement that "There is nothing more precious on this earth than the seeds of noble blood". On the opposite wall a quotation from "Mein Kampf" stands out in equally bold relief: "Indem ich fur die Deutsches Zukunst kämpfe, muss ich kämpfen fur die Deutsche Scholle, und muss ich kämpfen fur den Deutschen Bauern". In an adjoining section a propagandic pedigree of the 'Fuhrer' emphasises his association with the peasant class. The inevitable Jew-baiting takes the form of a series of 'selected' pictures of Semitic types bearing the sarcastic legend "Der Jude Harry Chaim genannt Heinrich Heine sagt im Buch der Lieder: 'Alle Menschen gleich geboren, sind ein adliges Geschlecht'". Alongside are several anti-Semitic cartoons, supported by Herr Hitler's opinion that the Jew can never be a German and that he will always work for the 'Grossere Idee' of his own race. The organisers of the Exhibition would have done better if they had refrained from degrading an otherwise excellent scientific exhibition with such propaganda.

The Exhibition concludes with a 'Mikrovivarium' and a section entitled 'Wohnung and Siedlung'. In the former, living micro-organisms and parasites are projected on a screen and explained by attendant demonstrators. In the latter, a series of models illustrates the improvement of housing conditions for the working classes, the central attraction being a full-size example of the suburban houses provided for working men. As one leaves the Exhibition, one feels that modern Germany has not only caught something of the spirit of the lines which adorn the cover of this journal, but has also succeeded to an admirable degree in translating it into practice.

I am indebted to the Hon. Mrs. Ursula Grant Duff and Dr. Bruno Gebhard, scientific director of the Exhibition, for many courtesies in connexion with my biological inquiries in Germany.

CEDRIC DOVER

Constitution and Properties of Some Non-Ferrous Metals and Alloys

THE spring meeting of the Institute of Metals was held on March 6–7, in the hall of the Institution of Mechanical Engineers.

To all interested in the lead-tin-antimony alloys, and particularly those used for type metals, the paper by Frances D. Weaver will be of especial value. In addition to the working out of at any rate the main features of this diagram, a considerable amount of data is available concerning the hardness properties of those alloys most commonly employed.

Prof. D. Hanson, in collaboration with Mr. E. J. Sandford, has continued his work on the influence of small amounts of other elements on the properties of tin. The metals investigated in the present work are aluminium, manganese and bismuth, the results with the first metal being perhaps particularly important in that there is a very definite time effect. The greatly improved properties obtained immediately after preparation are not permanent; deterioration of the alloy commences at the skin and spreads slowly inwards and spontaneous cracking takes place. Bismuth also increases the tensile strength of tin very considerably and refines the grain size.

Mr. W. E. Prytherck has examined the mechanical properties of some wrought magnesium alloys, and although no alloys of this metal have yet been produced which respond to heat treatment in the manner which is characteristic of certain well-known aluminium alloys, some of the materials studied have distinctly interesting and promising properties. The work which they have carried out over a number of years on the investigation of unsoundness in aluminium alloy castings is continued by Prof. Hanson and Mr. I. G. Slater, who have examined the effect of the pressure of the atmosphere under which a metal solidifies. They have shown that pressures from fifty to a hundred pounds per square inch are sufficient to remove all visible traces of pin-holes from sand-cast ingots, and that the densities of such castings, particularly those prepared under the higher pressures, are appreciably greater than can be obtained from ingots poured from melts treated by the various de-gassing processes. The tensile properties of certain alloys are considerably improved by solidification under pressure, but the fact is noted that in some instances, reheating the casting, by causing the liberation of the gases contained in solution, may give rise to blisters and cavities.

The penetration of molten solders into strained non-ferrous metals has been examined by a number of workers. Mr. L. J. G. van Ewijk contributes an account of a similar type of cracking in heat-treated nickel-chromium steel. The zinc chloride flux is shown to be innocuous, and it is clear from the inter-crystalline nature of the fracture that the penetration here is of exactly the same order as that which has been found in non-ferrous alloys. One of the interesting features of the work is the considerable difference in the susceptibility to this type of embrittlement to be found in the various nickel chromium steels themselves. There is some indication, however, that a high impact value results in a material which is relatively immune. Tests carried out on two plain carbon steels suggest that these are not liable to fracture under the conditions of the test. Whether, however, this is due merely to the composition of the material, or to the fact that the tensile strengths of these plain carbon steels were distinctly lower than those of the nickel-chromium ones, whence presumably the carbon steel contained less internal stress, is not clear.

The effect of five years exposure to urban atmospheric conditions on the strength and electrical resistance of some non ferrous wires is reported on by Mr. J. C. Hudson. The work shows that electrical resistance measurements may be used to give a fair idea of the extent to which corrosion proceeds. Among the materials investigated copper stands out pre-eminently, whilst the most corroded material of all was galvanised iron wire, which rapidly failed once the zinc coating had been corroded away.

Dr. H. J. Gough and Mr. D. G. Sopwith give an account of further experiments on atmospheric action in connexion with fatigue. The results of the tests on copper and brass suggest strongly that the acid and alkaline impurities present in the atmosphere can have little, if any, influence on atmospheric corrosion fatigue, and that oxygen in the presence of moisture is probably primarily responsible. The results of the tests on oxygen-containing and de-oxidised coppers show that the comparative behaviour of these materials, when tested in air and in a partial vacuum, is unaffected by the different compositions of the dissolved gases present. Corrosion fatigue, in this instance of duralumin, is also the subject of the paper by Messrs. I. J. Gerard and H. Sutton, who show that coatings of organic resins and enamels afford a very high degree of protection, especially when the metal had previously been subjected to the anodic treatment. The best results were obtained with a coating of synthetic resin varnish stoved for two hours at 150° C., metal so treated giving a fatigue limit of plus or minus 12·2 tons per square inch for ten million reversals.

Other papers were concerned with the reduction by hydrogen of stannic oxide in high conductivity copper, by Dr. Alkins and Mr. A. P. C. Hallowes, the spectrographic analysis of aluminium and a consideration of certain phases in the silver-cadmium alloys. F. C. T.

Science News a Century Ago

Shipping Statistics for 1834

On April 20, 1835, Lieut.-Col. Sykes communicated to the Statistical Society an appendix to his paper on "The Increase of Wealth and Expenditure in the Various Classes of Society". In this he gave particulars of shipping and trade from January 5, 1834 until January 5, 1835. The increase in this period in the number of British vessels employed in foreign commerce, he said, was 689 ships of 108,562 tons burthen, value £1,411,356. The net receipts in the Customs duties had risen from £17,577,549 to £19,931,687. In the year there cleared inwards 11,678 British vessels employed in the foreign trade of a burthen of 2,108,492 tons, which at £12 a ton represented a capital embarked of £25,301,904. The increase in the declared value of exports of the British and Irish manufacturers was £2,052,542, the total amount for the year being £36,541,926. The surplus disposable balance of the public revenue for the year ending January 5, 1835 was £1,608,155 after payment of all charges.

Meteorological Observations by Sir John Herschel

The *Athenæum* of April 25, 1835, contained a long abstract from a letter from Sir John Herschel at the Cape, to J. Hudson, late assistant secretary to the Royal Society. The letter dealt mainly with meteorology, and in it Herschel said that the South African Literary and Philosophical Institution had appointed a Meteorological Committee and had passed a resolution that "On four fixed days in each year, 21st of March, 21st of June, 21st of September and 21st of December ... we undertake to make horary observations of the barometer, wet and dry thermometer, clouds, wind, meteors, etc. etc. at the commencement of each hour (per clock) mean time at the place for thirty six hours, beginning at six o'clock in the morning of the 21st and ending at six o'clock in the evening of the 22nd. Thus a complete twenty four hours is sure to be embraced in corresponding, or at least, interpolable observations for all *longitudes*". Speaking of his measures with his actinometer, Herschel said, "The following may give you some notion of the purity of our sky and the force of our sunshine.

Effect observed here the day before yesterday 48°75
Usual effect of ordinary good sunshine in England 25°30

I find this instrument extremely sure and uniform in its indications, and having now had nearly eleven years' experience of it, I can safely say that it is perfectly adapted to the purpose. For this reason I shall draw up and forward to the Royal Society, very shortly an account of its construction and use".

Death of Capt. Henry Kater

On April 26, 1835, Capt. Henry Kater died in London. Born at Bristol on April 16, 1777, he came of a family of German extraction. At first he studied law, but at his father's death in 1794 he joined the Army as an ensign and sailed for India. There he came under Lambton's notice, and was employed on geodetical work. After a few years work in various parts of India, ill-health drove him home, and after further service in England in 1814 he was placed on half-pay and henceforth devoted himself to science.

Kater was best known for his geodetical work. His memoirs in the *Philosophical Transactions* from 1813 until 1828 refer mainly to the accurate construction and use of the pendulum, the balance and astronomical instruments. He applied Huygens's principle of the reciprocity of the centres of oscillation and suspension of pendulums; in 1818 ascertained accurately the length of the seconds pendulum in London, and during 1821–23 was associated with Arago, Mathieu and Colby in the determination of the difference of longitude between Paris and Greenwich. He compared the standard weights and measures of France, England and Russia, and also constructed various standards for Russia. Elected fellow of the Royal Society in 1815, he was awarded the Copley Medal in 1817 for his experiments on pendulums, and from November 1827 until November 1830 was treasurer to the Royal Society.

Societies and Academies

Dublin

Royal Dublin Society, March 26 W. Hughes · Investigations on the control of seedling disease of sugar beet A trial was made of the effectiveness against the blackleg disease of sugar beet, of the bulk seed treatment carried out by the Continental producers, in comparison with treatment with various disinfectants in small lots before sowing and with no treatment A germination test indicated that in the bulk seed treatment some injury was caused by too long contact between seed and disinfectant In a randomised field experiment, the following materials used before sowing gave a significant increase in establishment of seedlings over the control- Germisan and Ceresan (U T 1875 A), 27 6 per cent, Granosan, 25·6 per cent, and Ceresan (old), 21 7 per cent The remaining five treatments, which included the seed producers' treatment in bulk, were not significantly better than the control Seed treatment is recommended as a necessary insurance E T S Walton Artificial radioactivity

Paris

Academy of Sciences, March 4 (*C R* , **200**, 793–868) Emmanuel Leclainche Notice on [the late] Theobald Smith Mark Krein Derivatives of Mercer's nuclei A Tiemlakoff The growth of functions satisfying linear partial differential equations of the second order Alexandre Smohorshewsky Orthogonal polynomials Antoine Magnan A rapid kinematograph for films 9 mm wide, giving 1,500 2,000 images per second A simplification of an apparatus previously described A film taken with 2,000 images per second can be projected showing 16 views per second This slow-motion film has been applied to show the motion of a rebounding ball, the wing motion of a bird and the movement of the lips of a person speaking Pierre Lejay The interpretation of observations of the intensity of gravity made in the Philippines, in Malaya and in the Dutch Indies The anomalies found on land confirm the results of Vening-Meinesz made at sea The results appear to be connected with the great instability of the surface layers There is great tectonic activity, there are dozens of active volcanoes and earthquakes almost daily. Jacques Métadier · The Brownian movement in the Hilbert space. Hyperquantification and superquantification. Pierre Vernotte : The formulation of experimental laws The uncertainty which results for the interpretation of physical phenomena Application to the law of reactivity A discussion of the representation of experimental facts by mathematical expressions It is concluded that although an expression can be found which will represent a set of experiments with precision, a physical interpretation of a phenomenon cannot be based on the analytical expression which represents the experiments André Egal . The measurement of the velocity of marine, submarine or aerial vessels by compensated thermocouples Jacques Errera and Pol Mollet : Intramolecular isomerisms and infra-red absorption spectra The absorption spectra of the three hydroxybenzoic acids and of *o*-chlorphenol confirm Sidgwick's theory of cycle formation. A. Ionesco : Structure of the absorption bands of acetylene in the ultra-violet Georges Costeanu, René Freymann and Aurel Naherniac : Study of the absorption spectra in the near infra-red of liquid, gaseous and dissolved ammonia The observations suggest the existence of polymers for liquid ammonia or ammonia in concentrated solutions Mme Jacqueline Zadoc-Kahn Eisenmann The electric double refraction of para-azoxyanisol in the isotropic state René de Mallemann and Pierre Gabiano The magnetic rotatory power of ammoniacal nitrogen Frederic Joliot and Lew Kowarski The production of a radiation with energy comparable with that of the soft cosmic rays Study of the radiation produced by irradiating a silver plate with neutrons emitted by polonium + beryllium Pierre Preiswerk Experiments on the radio-activity produced by neutrons Victor Henri and Wladimir Lasareff The ultra violet absorption spectrum of methylamine Paul Job The coloration of nickel salts in hydrobromic acid solution. Application of the law of mass action in concentrated solution André Boullé The application of differential thermal analysis to the study of the anhydrous sodium metaphosphates André Chrétien and Pierre Genet Disodium ortho arsenate and its hydrates Fernand Gallais Iodomercuric acid From a study of the changes in the magneto-optical properties of solutions of mercuric chloride produced by the gradual addition of hydriodic acid, it is inferred that iodomercuric acid has the composition H_2HgI_4 Al Favorsky and Mlle Tatiana Favorskaja The gradual molecular acetylene-allene dienic transposition of the halohydrins. Joseph Wiemann The synthesis of a methyl and dimethylhexite J Franc de Ferrière The history of the soils of the lower terraces of the Rhine in Haute Alsace Georges Renouard The upper Stephanian and the Permian of the Villé basin in Alsace Georges Dubois and Mme Camille Dubois The results of pollen analyses of Flandrian coastal peat between Penmarc'h and Concarneau Georges Schneider The variations of the yield of the thermal springs of Aix-les-Bains G Demetrescu The study of seismograms R Guizonnier The phase of the diurnal component of the gradient of terrestrial electric potential Henri Colin and Eugène Bougy Sugar, ash, nitrogen and phosphorus in fodder and sugar beets and in their hybrids The forage beet has more ash, less sugar, more nitrogen and more phosphorus than the sugar beet Jean Chaze and André Sarazin . Contribution to the study of the mole, a disease of cultivated mushrooms Mme Andrée Drilhon Calcium and casting the shell in Crustacea Joseph Meierhans . The behaviour of physostome fishes after extirpation of the air bladder Yervante Manouélian Rabies, Borna's disease and peripheral neurones Baruch Samuel Levin and Iwo Lominski The action of soft X-rays on micro-organisms. Georges Blanc and L A Martin Experimental iridocyclitis produced by the typhic virus.

Brussels

Royal Academy (*Bull. Classe Sci* , **21**, No 1) G Cesàro : Equation and form of the curve for which $\delta = k \,.\, \sin \alpha/\alpha$ (k = const), if δ is the length of the perpendicular from the origin on to one of its tangents and α the angle which this perpendicular makes with the x-axis E. Henriot The antisymmetric aspect of electro-magnetism torque and momentor. The importance of antisymmetrical quantities in electromagnetic theory is emphasised, and two tensors are defined—the torque tensor and the momentor E. De Wildeman : Adventitious buds in Congolese varieties of *Hœmanthus* P. BURNIAT. Birational transformations of space having two isolated associated fundamental points (3) Transformations T_3 and T_4 J. F COX. Representation of the whole surface of the earth in an equilateral triangle Formulæ and examples of conformal and equivalent projections in an equilateral triangle. J VAN MEIGHEM Equations of perturbation of perfect piezotropic fluids This paper establishes the equations in the case when the field of the Lagrangian variables of the perturbed movement does not coincide with that of the unperturbed movement G BALASSE and MLLE GALET. Spectra of iodine with feeble excitation A correction J. PASTEELS: Morphogenetic movements of the gastrulation in turtles J TERBY Attempt to explain the mitosis of *Spirogyra* by that of *Plasmodiophora*

GENEVA

Society of Physics and Natural History, February 7 B SUSZ and E BRINER The Raman spectra of mixtures of nitric acid and nitrogen pentoxide The frequencies 1048^{-1} and 1396^{-1}, the intensity of which increases with the concentration of the pentoxide, appear to be connected with the presence of this substance W H SCHOPFER The solubility of growth factors

February 21 P ROSSIER (1) A colorimetric equivalent The application to a group of all spectral types of stars of a linear function of the abscissæ of the extremities of spectrograms of type *A* stars leads to an expression sensibly proportional to the colour index (2) The natural classification of stars If a number proportional to the percentage of stars of a spectral type less advanced than a certain limit is chosen as a variable independent of classification, it appears that certain inflections of some curves of colorimetric equivalents disappear.

VIENNA

Academy of Sciences, January 24 ERICH TSCHERMAK-SEYSENEGG. Hybridogenic pseudo-parthenogenesis ALEXANDER TORNQUIST The high metamorphic gravel beds of Tessenberg-Panzendorf in the eastern Tyrol. RICHARD WEISS and JAKOB KOLTES: Derivatives of 1 4-di α naphthylnaphthalene RUDOLF WAGNER Prefloration polymorphism of hexameric blossoms. A methodological investigation. RUDOLF ZIMARA · Mammals of West Africa.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, April 21

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 — M A Phillips "Gem Stones".*

Friday, April 26

ROYAL ASTRONOMICAL SOCIETY, at 4 30 —Discussion on "Gravity Measurements" to be opened by Dr. E. C. Bullard.

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP), at 6 45.—Annual General Meeting to be held at the Waldorf Hotel, Aldwych, London, W.C 2

Lord Amulree "A Historical Survey of Wage Adjustments"

GEOGRAPHICAL ASSOCIATION, April 26–29 Spring Conference to be held in Nottingham

Official Publications Received

GREAT BRITAIN AND IRELAND

Post Office Publicity By Sir Stephen Tallents (The Post Office Green Papers, No 8) Pp 24+12 plates (London H.M Stationery Office) 6*d* net

Annual Reports on the Progress of Chemistry for 1934 Vol 31 Pp 442 (London Chemical Society) 10*s* 6*d*

International Conference on Physics, London 1934 A Joint Conference organized by the International Union of Pure and Applied Physics and the Physical Society Papers and Discussions In 2 vols Vol 1 Nuclear Physics Pp viii+257 10*s* Vol 2 The Solid State of Matter Pp viii+183 10*s* Reports on Symbols, Units and Nomenclature approved by the General Assembly of the Union at its Meeting in London on 5th October 1934 Pp iv+40 2*s* 9*d* (London Physical Society)

Association of British Chemical Manufacturers Directory of British Fine Chemicals produced by Members of the Association Pp 62 (London Association of British Chemical Manufacturers)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1934, presented to the Annual Meeting, February 11th, 1935 Pp 51+6 (York Yorkshire Philosophical Society)

Department of Scientific and Industrial Research The Investigation of Atmospheric Pollution Report on Observations in the Year ended 31st March 1934 (Twentieth Report) Pp vii+108 (London H M Stationery Office) 5*s* net

Census of England and Wales, 1931 General Tables comprising Population, Institutions, Ages and Marital Conditions, Birthplace and Nationality, Welsh Language Pp ix+246 (London H M Stationery Office) 11*s* net

OTHER COUNTRIES

U S Department of the Interior Geological Survey Professional Paper 185-C The Recognizable Species of the Green River Flora By Roland W Brown (Shorter Contributions to General Geology, 1934–35) Pp ii+45–77+plates 8–15 10 cents Professional Paper 185–E Miocene Plants from Idaho By Edward Wilber Berry (Shorter Contributions to General Geology, 1934–35) Pp ii+97-125+plates 19–24 10 cents (Washington, D C Government Printing Office)

The Imperial Council of Agricultural Research Miscellaneous Bulletin No 4 Host Plant Index of Indo Ceylonese Coccidæ By S Ramachandran and Dr T V Ramakrishna Ayyar Pp iii+113+x (Delhi Manager of Publications) 1 10 rupees 2*s* 9*d*

The Woody Plants of Natal and Zululand By Dr J S Henkel Pp xii+252 (Pietermaritzburg Natal University College)

Argeologiese Navorsing van die Nasionale Museum, Bloemfontein Deel 2, Stuk 1 Die Oorblyfsels van Buispoort en Braklaagte, Noordwes van Zeerust Deur Dr Ir E C N Van Hoepen en Dr A C Hoffman Pp ii+25+12 plates (Bloemfontein Nasionale Museum)

U S Department of Agriculture Miscellaneous Publication No 207 Raising Reindeer in Alaska By Lawrence J Palmer. Pp ii+41 (Washington, D C Government Printing Office) 5 cents.

U S Department of the Interior Office of Education Bibliography No 29 Good References on The Curriculum and Social Change Compiled by Katherine M Cook and Florence E Reynolds Pp 10 Gratis Bulletin, 1934, No 12 Privately Controlled Higher Education in the United States By Fred J Kelly and Ella B Ratcliffe Pp v+56 10 cents Bulletin, 1934, No 18 High-School Clubs By Maris M Proffitt Pp v+64 10 cents Pamphlet No 50 Public Education in the Virgin Islands By Katherine M Cook Pp viii+32 10 cents Vocational Education Bulletin, No 177 Vocational Agriculture in relation to Economic and Social Adjustments, Report of Conference on the relation of Vocational Agricultural Education to Emergency and Long-Time Programs affecting Agriculture Pp xviii+67 10 cents (Washington, D C Government Printing Office)

Transactions of the San Diego Society of Natural History Vol 8, No 5 Three New Species of Pinnixa from the Gulf of California By Steve A Glassell Pp 13–14 Vol 8, No 6 New Marine Mollusca from West Mexico, together with a List of Shells collected at Punta Penasco, Sonora, Mexico By Herbert N Lowe Pp 15–34+plates 1–4 Vol 8, No 7 New Species of Mollusks of the Genus Triphora By Fred Baker and V D P Spicer Pp 35–46+plate 5 Vol 8, No 8 New Trilobite Species from the Anthracolithic of Northern California, and Griffithides Conwayensis, a New Name for a Trilobite Species from the Atoka Formation of Arkansas By Harry E Wheeler Pp 47–58+plate 6 Vol 8, No 9 Revision of some California Species of Astrodapsis By George L Richards, Jr Pp 59–66+plate 7 (San Diego Society of Natural History)

India Meteorological Department Scientific Notes Vol 6, No 61 Evaporation in India calculated from other Meteorological Factors By P K Raman and V Satakopan Pp 52 1 12 rupees, 3*s* Vol 6, No 62 The Distribution of Temperature in the Upper Levels of a Depression originating in the Bay of Bengal during the Indian South west Monsoon By N K Sur Pp 53–56+2 plates 5 annas 6*d* (Delhi. Manager of Publications)

Smithsonian Miscellaneous Collections Vol 93, No 3· New Earthworms from China, with Notes on the Synonymy of some Chinese Species of Drawida and Pheretima By G E Gates (Publication 3293) Pp 19 (Washington, D C Smithsonian Institution.)

CATALOGUES

A Catalogue of Books in New Condition offered at Greatly Reduced Prices (Catalogue 449) Pp 80. (Cambridge W Heffer and Sons, Ltd)

The Gardener's Library· a Comprehensive List of Books on all Branches of Modern Horticulture and a Selection of the Early Literature. (New Series, No. 39) Pp 44. (London Wheldon and Wesley, Ltd.)

Zeiss Microscopes and Accessories (Mikro le) 1934 edition Pp 158. (London Carl Zeiss (London), Ltd)

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The Dyestuffs Industry and its Lessons

THE story of the dyestuffs industry has often been told, at least in part Few accounts have been more vivid than that given by Mr C J T Cronshaw, managing director of the Dyestuffs Group, Imperial Chemical Industries, Ltd , in his Jubilee Memorial Lecture of the Society of Chemical Industry No such glimpse of the industry from inside has been vouchsafed us since Mr James Morton gave us the story of Caledon Jade Green and later of Caledon Brown Mr Cronshaw's lecture, however, was far more than mere recapitulation He succeeded not merely in revealing some of the difficulties and problems which the industry presents to those engaged in it, but also its ever-changing aspects and its intricate and intimate relations with other industries

It would be difficult to find an industry more essentially dynamic than that of dyestuffs Its very success in ousting the natural colouring matters proved but the prelude to adventure The wider range of shades, the greater brilliance and enhanced fastness of the synthetic colours led to more and more searching demands Not merely textiles but almost every other material in common use has come to the industry with its demands for colour, and the newer industries, like the rayon industry have often made but halting progress until those demands were met Despite its vicissitudes, despite the long struggle for mere existence, the British industry has an honourable share of the outstanding advances to its credit, and those in the post-War period are not unworthy of comparison with the discoveries from which the industry took its birth

The career of the late Dr Duisberg in itself gives some clue to the astonishing fecundity of the industry An impressive feature of the brilliant discoveries of this great industrialist is their close connexion with the most recent advances of his day in organic chemistry Equally significant is the illustration his discovery of phenacetin affords of the relation between the dyestuffs industry and other branches of the organic industry When all allowance is made for the stimulus provided by the discovery of the therapeutic properties of acetanilide, Duisberg and Hinsberg really commenced their research through the necessity of finding an outlet for the *p*-nitrophenol which was accumulating at an alarming rate as a result of the very success of the manufacture of the benzopurpurins.

The discovery which first led the Bayer Co. into the field for which it has since become world famous has been repeated again and again in its essential features It is the very intimacy of the links between the dyestuffs industry and other industries which makes possible the astonishing versatility of the chemist in this industry and the immense range of products which he can provide Unless his intermediate products and by-products found outlet in other industries as vulcanisation accelerators for rubber, antioxidants for rubber or oils and fats, preservatives for wood and other materials, as gum inhibitors, for the control of insect pests and animal or plant diseases, in the manufacture of fine chemicals, pharmaceutical products, and synthetic resins, as softeners, solvents and the like for lacquers and varnishes, finishing agents of all kinds for the leather and textile agents, the resources of the industry would be severely limited by the dead weight of waste products which it would be compelled to carry

Under modern conditions, this factor is even more important The growing demand of the colour-using industries for novelties for specific purposes could scarcely be met in the range required or at an acceptable price but for the way in which intermediate products and by-products can be used for many different and unrelated purposes Nor are the relations static The reaction of the synthesis of indigo on the manufacture of indigo, and its influence on the displacement of the Weldon and Deacon processes for chlorine by the electrolytic process, are paralleled again and again within the dyestuffs industry as in its relations with other industries For example, the introduction of sulphonated fatty alcohols as detergents has given an impetus to the use of fatty compounds for other purposes including dyestuffs, and the dyestuff chemist is no longer content to restrict himself to the use of methyl, ethyl and even butyl alcohol The delicate balance between by-product and main product, the utilisation of waste materials, the competition of raw materials and alternative routes, is proceeding almost as freely to-day over the field of aliphatic chemistry as in the past it has done in the aromatic field.

The existence of such complex relations makes it easy to understand why a man like Dr. Duisberg could find intense satisfaction in the leadership of such an industry despite the brilliancy of his earlier scientific work He at least could never be said to have left the field, and his career seems to underline the argument advanced by Mr Cronshaw in support of the view that the chief factor in the decline of the industry in Great Britain—a decline which no one noticed at the time—was lack of foresight on the part of the originators of the industry themselves

The facts speak for themselves Perkin was a rich man when he retired in 1874 at the age of thirty-six Nicholson retired six years earlier when forty-one, also wealthy, and though Greville Williams remained until 1877 he was then only forty-eight On the face of it the very success of the industry was its undoing There were no long years of drudgery and inadequate reward The industry prospered from the start, and the dyeing trade received the new products well The future prospects were equally bright The textile industries were peculiarly ready for the exploitation of the new dyes The cotton and wool trades were both on the threshold of great expansion, while Mansfield's isolation of benzene from coal tar had provided the industry with unlimited raw material on its doorstep.

Perkin, in fact, could scarcely have made his discovery at a more appropriate or auspicious time, and the explanations advanced of his withdrawal from the industry are unconvincing He at least recognised that the dyestuffs industry was founded on scientific discovery and developed side by side with it None the less he did not see that the greatest service he could have rendered to research in Great Britain was to retain the leadership of the industry he had brought into being , instead, the leading technologist of his day turned his back on the industry at an age when his powers of leadership should have been ripening, alike in the consolidation of results achieved and in the inspiring of other workers with his own enthusiasm

In the light of to-day, it seems incredible that at a time when organic chemistry was still young and vigorous, and when the science as we know it to-day was rapidly taking shape on the foundations laid by Kekulé's theory, a mind such as Perkin's should have turned away from this field. The history of the next decade alone sufficiently endorses Mr. Cronshaw's words: "the industry languished because the pioneer spirit and the creative instinct which brought it into being abandoned it too early, little knowing that what they had accomplished was the merest scratch on the surface. There remained whole new worlds to conquer". Other factors there were undoubtedly, but the charge of lack of foresight appears to be only too well founded

Without foresight, neither in pure nor in applied science does Nature readily yield her secrets, and success in the dyestuffs industry has always depended largely on the receptivity of ideas and the creative powers which are associated with vision. The displacement of the natural colouring matters merely intensified the struggle for the survival of the fittest among the synthetic dyes themselves. In the marketing to-day of products designed to meet more and more the demands of the user in regard to shade, the fabric or purpose for which the colour is required, the conditions of fastness, the method of application and other factors, the industry depends more than ever upon the exercise of just those qualities which are inherent in all enduring scientific work Indeed, in any scientific industry to-day success depends upon the continuous application alike in the laboratory, in the works or in the management of the assiduous search for facts, the eternal vigilance and the creative instinct and vision which are of the spirit of science itself

Reviews

Relativity and Cosmogony

Relativity, Gravitation and World-Structure By Prof E A Milne (The International Series of Monographs on Physics) Pp x+365+4 plates (Oxford Clarendon Press, London Oxford University Press, 1935) 25*s* net

IN 1932, Prof E A Milne pointed out that, if the galaxies were initially concentrated in a small volume, those with highest speeds would by now have reached the greatest distances, we might in this way account for the well-known observational result that their radial velocities are approximately proportional to their distances This idea has grown in less than three years into the large treatise now before us The original idea is almost lost in the subsequent accretions, but the spirit of it remains The outlook throughout the book is that the cosmological problem is primarily a matter of kinematics Dynamics, wherever it appears, is treated as the servant of kinematics

A review of the book must necessarily be a review of the theory that it promulgates It is characteristic of modern researches on world-structure that the same physical theory is often expressed in many variant forms, both mathematical and conceptual A confusion of tongues has descended on those who would build a tower whose top may reach unto heaven! On opening Milne's book, it is soon apparent that we shall be asked to learn a new language, but it is not so clear that the language is going to be used to describe a new world. Most of his critics have occupied themselves with the question, not whether Milne's theory is right, but whether it differs from current relativity cosmology. On this point the book is not so helpful as it might have been. Making all allowance for the author's natural desire to present his theory in his own way uncontaminated by conceptions or terminology which he dislikes, we think it is hard on the reader that he should be kept waiting until §463 to learn whether the Milne universe differs from the ordinary 'expanding universe', or whether it is the same universe described in another way When at last we are shown that there is a definite observable difference, we are left mystified as to how the difference has arisen

A 'cosmological principle' is placed in the forefront of the discussion, namely, that a number of equivalent observers arrive at the same description of the universe relatively to themselves—not only of its laws, but also of its actual material contents Milne explains that this principle is merely a specification of the particular system which he has chosen to investigate, and is not supposed to be a law of Nature To use the term 'principle' in this way seems unfortunate When later he finds, in the system so specified, particles the properties of which are like those of cosmic rays, we congratulate him on the happy resemblance of his selected model to the actual universe But we fail to see that he has in any way accounted for cosmic rays. The particles occur in his model because, in specifying his model, he put them there That he did so undesignedly does not affect the question

For the determination of location in space and time, the only means of exploration permitted is interchange of light-signals Milne will not allow his observers to transport scales or clocks He argues that observers elsewhere could not be provided with "rigid-length scales, copies of our own, because we could not say *a priori* what we meant by their being copies". I do not think the National Physical Laboratory would have any difficulty in issuing instructions by which an observer, say, in the Andromeda Nebula, could construct a standard metre; and I do not see the force of Milne's objection to determining lengths in all parts of the universe in this way To exclude such methods has the drawback that it divorces a great part of practical physics from the theory When I visit the Cavendish Laboratory, I do not find its occupants engaged in flashing light-signals at each other, but I find practically everyone employing rigid scales or their equivalent Sooner or later, the theory must face the task of identifying the significance of these rigid-scale measurements in terms of its symbols, otherwise the greater part of experimental physics will be outside its purview

It is well known that when the means of exploration is confined to light-signals, we reach Weyl's theory in its original form with entirely indeterminate gauge Our first impression was that this might be the origin of Milne's departure from current theory—that he had adopted a different gauge system, having disallowed the rigid-scale measurements which would have refuted it But by p 34 Milne seems to have returned to orthodoxy, and the physicist's favourite transportable clock, namely, the atom, is being freely used If we may "make an immediate recognition" that two carbon atoms are identical clocks, why may we not make an immediate recognition that the grating spaces of two diamonds are identical standards of length ?

Milne's system of particles forms a spherical expanding universe and agrees in this respect with the systems studied, by Friedman and Lemaître But there is a difference in the law of motion, so that a particle in Milne's system does not follow a geodesic So far as I can make out, the difference has arisen in the following way In the Lemaître model, observers who are at rest in the spherical co-ordinate system would give a precisely similar description of the universe and are therefore "equivalent observers" in Milne's sense, but, owing to the accelerated expansion of the universe, they are accelerated away from one another as judged by the Doppler effect Milne, on the other hand, postulates that his equivalent observers shall be in uniform relative motion as judged by the Doppler effect, his universe must therefore have a constant, instead of an accelerated, rate of expansion He has accordingly changed the law of gravitation so as to give a uniform expansion.

There is a passage in the book (§69) which suggests that it is only the analytical difficulty which has prevented Milne from considering equivalent observers with accelerated motion If the uniformity of the expansion is not an essential part of the theory, it follows that his alteration of the accepted law of gravitation is not an essential part of the theory. Perhaps therefore when he has extended the theory in a way which he seems to be already contemplating, we may yet celebrate the return of Prof Milne to the folds of orthodoxy.

A. S. E.

A History of Civilisations

A Study of History By Prof Arnold J Toynbee (Issued under the auspices of the Royal Institute of International Affairs) Vol 1 Pp xvi+476 21*s* net Vol 2 Pp vii+452 21*s* net Vol 3 Pp vi+552 21*s* net (London Oxford University Press, 1934) 3 vols, 52*s* 6*d* net

SINCE it is commonly agreed that western civilisation has now reached a supreme crisis in its history, since disillusionment, rife among laymen and men of science alike, is poisoning the well-springs of the spirit, and since the most passionate desire of men of goodwill is to discover means of overcoming our present difficulties, any book which can help us to get our bearings and to see our problems in true perspective must command much closer attention than in easier times Prof Toynbee's superb and philosophic "Study of History", of which the present volumes are the first section, is such a book

The plan of the whole work has been conceived on a grand scale Regarding civilisations, like other manifestations of life, as entities which must be born, which may grow, and which, pending an evolution not yet completed, are doomed to die, Prof Toynbee has taken the life-histories of civilisations present and past as the objects of his study His book will therefore examine the circumstances of their genesis and growths, their breakdowns and disintegrations It will investigate certain major phenomena in their history universal churches, the centres of the spiritual travail which accompanies the downfall and precedes the birth of most civilisations, universal States, the receptacles into which civilisation's earlier and smaller political articulations are usually poured before the end, 'heroic ages', the temporal no-man's lands between related civilisations, through which the outer barbarians of the time, loosed for a while from their established anchorage, wander during the throes of social decay and birth It will explore the contacts of civilisations in space and their contacts and rhythms through time. All this analysis will then be focused on the present outlook of Western civilisation—doubtless with the object of offering our troubled age such guidance as history can give those whose capacity for learning from the experience of others is not blunted by their own preoccupations, and the book will finally close with a survey of the inspirations of historians.

The present volumes do not cover the whole of this immense ground, but are limited to finding civilisations for comparative study, establishing their suitability for this purpose, and examining the conditions of their birth and growth. The developed civilisations, about which enough is known for Prof. Toynbee's purpose, number about a score. They include Western civilisation and its living contemporaries—the Orthodox Christian, Islamic, Hindu and Far Eastern civilisations; and, among earlier examples, the Hellenic (or Greco-Roman), Sumeric and Egyptiac civilisations in the Old World and the Mayan and Andean civilisations in the New World. In Prof. Toynbee's view, these ten civilised societies, together with ten or twelve more which the "Study" describes in some detail, are neither links in a continuous chain nor cells in a single growing tissue, but separate entities, each with a life of its own.

On this assumption, some twenty cases of birth and successful growth have to be explained. Usually the genesis and development of civilisations (in the plural) or civilisation (in the singular) are attributed to environment or racial superiority. Prof. Toynbee, in a closely reasoned and impressive argument, rejects both alternatives. His own explanation is hard doctrine. In his view, neither the birth nor the subsequent growth of a civilisation can be accounted for on the flattering assumption of racial superiority or by the quasi-automatic operation of environment. On the contrary, both genesis and development are the outcome of a stern and difficult relationship between men and their surroundings; and examples of abortive and arrested civilisations clearly show that this relationship, which he calls "Challenge-and-Response", by no means necessarily or inevitably produces birth or growth.

The conception of challenge-and-response is simple in essence and complex in its working out. Changing circumstances, Prof. Toynbee argues, confront societies, like individuals, with problems for solution; these problems constitute challenges; and out of the effort and suffering which response to them entails, civilisations are born and grow. In the case of the earliest civilisations which emerged from the primitive societies that were their forerunners, the challenges were mainly external and material; in the case of later civilisations affiliated to predecessors already civilised, the challenges have been mainly internal and spiritual. If either challenge or response is too easy, only a poor civilisation or none at all will result. If, at the other extreme, a challenge is overwhelmingly severe, though a tremendous effort at response may sometimes bring a civilisation to bud, it will neither flower nor bear fruit. But provided that the limits of capacity are not overstepped, the more severe a challenge and the greater the effort required to respond to it adequately, the richer will be the spiritual quality of the resultant civilisation.

Growth is a continuation of the same process. It is to be measured not in terms of material expansion or technical advance, but in terms of spiritual development and the transfer of the field of action from outward and material problems to inward and spiritual concerns. A growing civilisation is in unstable and not stable equilibrium, the instability resulting from the very fact that a successful solution to any problem by virtue of its sheer success in time causes fresh problems to emerge; until at last, if solutions are no longer achieved, breakdown begins.

The process of challenge-and-response, as analysed by Prof. Toynbee, works through the individual members of a changing creative minority, who must first spiritually withdraw for a time from active social life while the mystery of creation takes place in their own soul, and who, if they are to be socially effective, must then return to the far more formidable task of converting the majority of their fellows to understanding and effort. That so complex and difficult a process should sometimes succeed and sometimes fail is not surprising. But it is an advantage of Prof. Toynbee's analysis that it eliminates hocus-pocus and conceit from attempts to explain the birth and growth of civilisations and places responsibility for their development on the shoulders of the individuals from whom alone initiative can finally come.

So much for the inadequate summary which is all that can be given in a review limited in length to about a word for each of Prof. Toynbee's fifteen hundred pages. A subject so large, treated on a canvas so vast, obviously exposes an immense area for criticism and attack. The objection that, in taking all the civilisations he can find as his subjects of study, Prof. Toynbee has included too much, may be summarily dismissed since it is the very range of his material and his endeavour to find common features in its diversity of detail that constitute the central intellectual interest of his inquiry. Neither does it matter much, if at all, that he is not himself a first-hand authority over most of the field but has drawn freely on the labours of others. An architect need not personally make or lay all the bricks in his house; and Prof. Toynbee is an architect of ideas. Nor, finally, is it very important that here and there he turns to conjecture to fill in gaps in our knowledge of perished civilisations, for what records have survived to our time is far more a matter of chance than what stages they must have traversed in the process of birth and growth. Specialists may indeed question now and again Prof. Toynbee's handling and interpretation of detail; but since he always gives both his evidence and his reasoning, his readers can agree, qualify or dissent for themselves. Certainly men of science who use the empirical method in other fields will not object to Prof Toynbee for using it in the study of human history

Since the "Study" is not yet complete, a final appraisal is not now possible Some of its central propositions are, however, sufficiently apparent Prof Toynbee regards civilisations as plural and not singular—an opinion which, though fundamental to the entire work, will certainly excite much criticism Given the facts, which he sets forth very fairly, many readers indeed will agree with him, and will reject the technique of those schools of historians who attempt to cram into the crannies of a single *a priori* mould the infinite complications of civilised history On the other hand, Prof Toynbee's argument equally implies that the life-histories of civilisations contain recurring and significant regularities, an inference which will also be challenged by the different school which regards history as altogether patternless Recurrence and significance, however, are largely questions of the scale, framework, and concepts of study, and if it be granted that civilisations are plural, if civilised societies as a species can be distinguished from primitive societies by their common features of size, longevity and rareness, and if some of the civilisations which have been born have also died, then negatively there can be no *a priori* reason why significant regularities should not recur, while positively Prof Toynbee's *a posteriori* conclusions as regards birth and growth, the only portions of his subject so far studied in detail, certainly ring too true to common experience to be dismissed out of hand

A book is more than the facts and arguments it contains, and no sympathetic reader can rise from Prof Toynbee's "Study" without paying tribute to the vitality, imagination, and generosity of spirit which suffuse its pages Treading a path which few forerunners have sought or found, he takes his readers up to a high place and shows them all the kingdoms of the earth stretched out in a great vista across space and time "The supreme task of the age," wrote *The Times* on its hundred-and-fiftieth birthday, "is a large enough inspiration" To the accomplishment of that task the "Study" should contribute

JULES MENKEN

Short Notices

Air Ministry: Meteorological Office *British Rainfall, 1933 Seventy-third Annual Volume of the British Rainfall Organization Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1933, as recorded by over 5000 Observers in Great Britain and Ireland.* (M O 375) Pp xvii+293+4 plates. (London: H M Stationery Office, 1934) 15*s* net

THE general rainfall of 1933 was below the normal for the first time in eleven years, the percentage of the average of the 35 years 1881–1915 being only 80 for the British Isles as a whole, 82 for England, 80 for Scotland, 76 for Wales and 77 for Ireland Only an area in north-eastern England and a very small area in Hampshire had more rain than the normal in consequence of one or two heavy storms During the first quarter of the year, rainfall was more or less up to normal, there being a considerable excess in February, but October, and September in England, were the only other wet months June was remarkable for the exceptional number of violent thunderstorms, though the month was scarcely more impressive in this respect than June 1914 There were also heavy storms here and there in the later summer months, but the event of the year was undoubtedly the great snowstorm of February 23–26 in Ireland, Wales and part of England This is commemorated in the frontispiece showing a road heavily blocked with snow in Co. Carlow. An observer at Crickhowell in Breconshire, who was overtaken by the blizzard whilst on the mountains with some local farmers looking for sheep, states that they considered themselves lucky to have escaped with their lives, especially as they repeatedly had to take shelter in the rocks to avoid choking, so thick was the drift and so fierce the gale

As usual, this time-honoured annual contains some original papers These deal with percolation and evaporation at Grayshott in Hampshire by S E Ashmore, average rainfall over the county of London by J Glasspoole, and experiments with rain-gauge shields in exposed situations by F Hudleston Dr Glasspoole's paper shows the influence of relief on average rainfall even within the small area of London, but it seems to us a pity that he should have selected the now somewhat antiquated period 1881–1915 upon which to base the average rainfall of London It is now realised that meteorological averages are not stable In any event there is nothing sacrosanct about the 35-year period 1881–1915, even though it may be useful in our generation as a standard of comparison for other periods L C W. B.

Gmelins Handbuch der anorganischen Chemie. Achte Auflage Herausgegeben von der deutschen Chemischen Gesellschaft. System-Nummer 35: *Aluminium.* Teil A, Lieferung 1. Pp iv+284. (Berlin. Verlag Chemie G.m b H., 1934.) 43 gold marks.

IT seems to be uncertain to whom should be ascribed the first successful isolation of the metal aluminium. Davy, Faraday and Berzelius all seem to have met with a certain amount of success, but in 1856 Berzelius stated that after many unsuccessful or only partially successful attempts by Davy, Oersted, Wöhler and himself to isolate the metal, it was

Wöhler who ultimately succeeded in 1827. Accordingly, Wöhler is generally given credit for the discovery, but in recent years Fogh has put forward a strong claim of priority on behalf of Oersted (1824–25), and has shown that Oersted's method of reducing anhydrous aluminium chloride with potassium amalgam and distilling off the mercury from the product can be made to give satisfactory results.

The origin of the important product kaolin is still somewhat obscure, although it is clear that kaolin results from the degradation of complex minerals, principally through the agency of carbon dioxide. Disintegration of potash felspar may have been effected in three different ways, namely: (1) by the pneumolytic and hydrothermal action of volcanic gases, (2) by the action of atmospheric carbonic acid, and (3) by the action of vegetable acids from decayed organic matter. According to R. Schwarz and R. Walcker, kaolin and laterite are not to be regarded as primary products of weathering, but rather as secondary compounds synthesised from the potash, alumina and silicic acid which are formed during the continuous hydrolytic dissociation of potash felspar. Such a theory would account for both the comparative scarcity of kaolin and also the simultaneous formation of other so-called products of weathering. A table is given which shows the varying amounts of bauxite and laterite produced in various countries during the years 1925–31.

The different metallurgical processes in use are described fully, particularly the Hall-Héroult process, in which remarkable success was achieved by the happy combination of a number of ideas, every one of which had already been in use for some time. The remainder of the volume is devoted to the classification of the various physical properties of the metal.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lief. 420. Abt. 2: *Physikalische Methoden*, Teil 3, Heft 4: *Nachweis der biologisch wichtigen Körper durch Fluoreszenz und Fluoreszenzspektren*. Von Charles Dhéré. Pp. 3097–3306. (Berlin und Wien: Urban und Schwarzenberg, 1933.) 11.50 gold marks.

IN turning over the pages of this section of Abderhalden's great encyclopædia, one is impressed with the wealth of information imparted, much of which must be new to anyone not keeping abreast of current literature on the subject. The treatment is in four parts: (1) introduction (5 pages); (2) apparatus and methods (64 pages); (3) physical chemistry of fluorescence phenomena (20 pages); (4) a special part (96 pages).

The second part brings together in easily readable form detailed descriptions of a very wide range of apparatus and accessories, together with good practical accounts of their functions or applications. In the next part, dealing with the physical chemistry of fluorescence, one finds a robust treatment of the fundamental principles and methods of experiment in general terms, but not in such detail as to serve as a laboratory manual. Finally, in the special part, the work reaches its culminating point in the proving and identification of biological materials by fluorescence, and here the fruits of many thousands of applications are garnered. Carbohydrates, glucosides, fats, phosphatides, proteins, porphyrins, chlorophyll, animal principles, alkaloids (especially the numerous cinchona bases), and several other classes of substances command individual consideration. The book is well printed, the figures are good and the bibliography is rich in its detail.

Die Chemie des Pyrrols. Band 1: *Pyrrol und seine Derivate; Mehrkernige Pyrrolsysteme ohne Farbstoffcharakter*. Von Hans Fischer und Hans Orth. Pp. xii+460. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 28 gold marks.

THIS monograph on pyrrole chemistry satisfies a need which has long existed, for it is thirty years since an adequate account of the group has appeared. No author could be better qualified for the present task than Hans Fischer, whose life-work has been to extend, and in many directions to create, the knowledge of the chemistry of both the simpler pyrroles and of the polynuclear pyrrole derivatives.

The volume under review contains the simpler pyrroles and the polynuclear pyrroles without pigment character; a second volume is to discuss the pyrrole pigments, the porphyrins and chlorophyll, etc., and the physiological side of pyrrole chemistry. The work consists of a discussion of different types of pyrroles, their reactions and the methods for their synthesis, and provides at the same time a dictionary of all the pyrrole derivatives which are known. Particularly valuable are the preparative methods which are given, and the authors' observations on the most suitable means of synthesis of a given pyrrole should be most useful to future workers. As supplements are included an account of the derivatives of maleic acid obtained on oxidative degradation of pyrroles, which are therefore important for determination of constitution; also recommended methods for the preparation of starting materials for pyrrole synthesis. Consultation is facilitated by an elaborate index.

K. F. A.

Manual of Safety Requirements in Theatres and other Places of Public Entertainment. Issued by the Home Office, 1934. Pp. ii+106. (London: H.M. Stationery Office, 1935.) 2*s*. 6*d*. net.

THIS is a valuable, because most practical, summary of precautions against accidents of all kinds in places of public entertainment, with careful explanation of the reasons for them, and examples of disaster following neglect, and the 'requirements', mainly structural, and other 'conditions' to be observed by licensees. Suggestions for improvement of any future edition are welcomed, and will no doubt be forthcoming to a book so considerately planned and clearly expressed. There is an excellent index, and diagrams are provided for the more important safety devices. Everyone responsible for public entertainments should be acquainted with this manual.

Canadian Water Power Developments during 1934

By DR BRYSSON CUNNINGHAM

THE exploitation of hydro-electric power in Canada continues to make substantial progress, and as will be seen from the graph reproduced in Fig 1, from a report[1] recently issued by the Dominion Water Power and Hydrometric Bureau, the rate of development, despite the stagnation in trade, has not perceptibly slackened since the pronounced upward trend set in some fifteen years ago Although no new large water power undertakings were initiated during 1934, the continuation of work on a number of installations previously under construction led to the completion of new installations aggregating 214,965 horse-power, which were brought into operation during the year The total installation for the Dominion at the end of 1934 was 7,547,035 horse-power

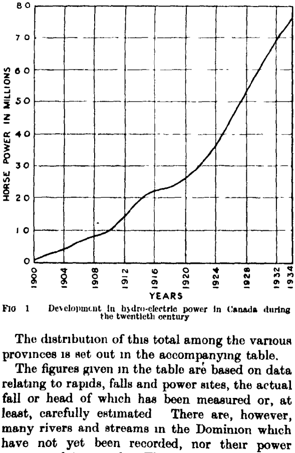

FIG 1 Development in hydro-electric power in Canada during the twentieth century

The distribution of this total among the various provinces is set out in the accompanying table.

The figures given in the table are based on data relating to rapids, falls and power sites, the actual fall or head of which has been measured or, at least, carefully estimated There are, however, many rivers and streams in the Dominion which have not yet been recorded, nor their power capacity determined These can only become available for tabulation as survey work proceeds, and much remains to be done in the less-explored districts of the north. Also, apart from definite studies of particular projects, no account has been taken of power concentrations which are feasible on rivers and streams of gradual gradient, where economic heads may be created by the formation of impounding dams As the actual water-wheel installation throughout the Dominion is found to average a development of power 30 per cent in excess of the tabular values for such cases, it is legitimate to infer that the present recorded water power resources of Canada will permit of a turbine installation aggregating about 43,700,000 horse-power, so that the realised power development at the present time is little more than 17 per cent of the ultimate possible development The figures in the table represent, in fact, the *minimum* water power possibilities of the Dominion.

In a previously issued statement[2], the Hon Thomas G Murphy, Minister of the Interior, commented on the situation and said that "the recovery in power demand remarked in 1933 gained in momentum during 1934 and the records of electrical output compiled by the Dominion Bureau of Statistics indicate that the total output for 1934 will not only greatly exceed that for 1933 but will have established an all-time record" In point of fact, it actually attained an increase of nearly 19 per cent over the previous record of 1930

AVAILABLE AND DEVELOPED WATER POWER IN CANADA, JANUARY 1, 1935

Province	Available 24 hour power at 80 per cent efficiency		Turbine installation
	At ordinary min flow	At ordinary six months flow	
1	2	3	4
	h p	h p	h p
British Columbia	1,931,000	5,105,500	717,717
Alberta	390,000	1,049,500	71,597
Saskatchewan	542,000	1,082,000	42,035
Manitoba	3,309,000	5,344,500	390 025
Ontario	5,330,000	6,940,000	2,355,755
Quebec	8,459,000	13,064,000	3 708,320
New Brunswick	68,600	169,100	133,681
Nova Scotia	20,800	128,300	116,367
Prince Edward Island	3,000	5,300	2,439
Yukon and North West Terr	294,000	731,000	14 199
Total	20,347,400	33,619,200	7,547,035

The increase in power installation during 1934 is principally accounted for by the completion of the Rapide Blanc development (about 160,000 horse-power) of the Shawinigan Water and Power Co on the St Maurice River, and by the installation of an additional unit (50,000 horse-power) for the Beauharnois Light, Heat and Power Co, near Montreal. The latter undertaking has already been described in NATURE[3], so that it is only necessary to refer to the former Through the courtesy of the Shawinigan Co., which has kindly

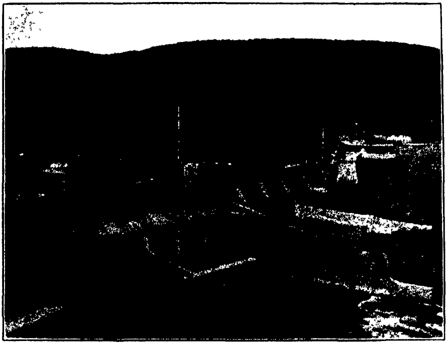

FIG. 2. Rapide Blanc power house and dam.

supplied particulars and photographs, it is possible to give a brief account of the important work at Rapide Blanc. The Company has previously exploited practically to the full extent, the hydraulic possibilities of the lower St. Maurice River, which discharges into the St. Lawrence at Trois Rivières, and their installations at Grand'mère, Shawinigan and La Gabelle, which were visited by the writer in 1927, have been described in NATURE[4].

A view of the structural work of the dam and the exterior of the power house at Rapide Blanc is given in Fig. 2, while Fig. 3 is a view of the interior of the power house showing the arrangement of the turbines. Unlike the installations of the Company elsewhere, there are no falls at Rapide Blanc, and the rapids themselves, before their submergence, were of no spectacular significance.

The development is best described as a typical medium head water-power station, the main dam and power house being located on the St. Maurice River at a point about 115 miles above Shawinigan Falls, which, in turn, are about 20 miles distant from Trois Rivières. The dam is of the usual standard gravity section, with the intake structure forming an integral part at the western end. Flood regulation is secured by the use of four steel regulating gates, electrically operated, and suitably protected against extremes of weather. Three of these gates are 50 feet wide by 36 feet deep, for the passage of 40,000 cu. ft. of water per second each, at normal water-level. The fourth gate is also 50 feet wide, but only 16 feet deep. In addition, there are two smaller gates situated near the main gates for minor flow regulation.

The water from the impounded area passes into the pump house through riveted steel penstock tubes, varying in diameter from 23 ft. to 19 ft., the shell thickness being approximately ¾ in. The power house (Fig. 3) will eventually contain six turbine generating units, of which four have been installed during 1934. The water wheels, supplied by the Dominion Engineering Works, Ltd., are rated at 38,000 horse-power each under 108 feet head and work at 109·1 rev. per min. Maximum efficiency is guaranteed as at least 90 per cent. The electrical generators, contracted for by the Canadian Westinghouse Co., are of the vertical type, each rated at 36,000 k.v.a., generating current at 11,000 volts, 85 per cent power factor, three phase, 60 cycles and 109·1 r.p.m. An unusual feature of the machines is that air is taken in for ventilating

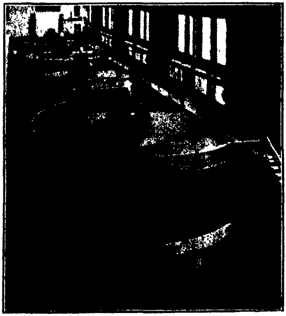

FIG. 3. Interior of Rapide Blanc power house, showing arrangement of the turbines.

purposes through the tops of the generators, as the main thrust bearings are located below the rotors Power is transformed from 11,000 volts to 230,000 volts in outdoor water-cooled transformers, supplied by the Canadian General Electric Co , and is transmitted direct to Trois Rivières by means of an overhead transmission line, 120 miles long With the addition of this installation, the Shawinigan Water and Power Co possesses a combination of power plants aggregating 809,200 electrical horse-power and 55,000 hydraulic horse-power

The enormous importance to Canada of its hydro-electric installations may be gauged from the fact that the investment represented by the present development of seven and a half million horse-power is conservatively estimated at 1,743,000 dollars and, while it is difficult to assign a precise figure to the coal equivalent of developed horse-power, the potential saving of coal through the present utilisation of water power is on a moderate computation equivalent to 36¼ million tons per annum The realised saving, dependent, as it is, on the actual output of the plants in operation, was during the year 1934, of the order of 17 million tons of coal The total installation gives a notable ratio of 697 horse-power per 1,000 of the population

[1] "Water Power Resources of Canada" Paper No 1813 Department of the Interior Ottawa

[2] Hydro-electric Progress in Canada in 1934 Paper No 1784 Ottawa

[3] NATURE 131 788 1933

[4] NATURE, 120, 334, 1927

The Classification of Coals

By Dr R Lessing

THE complexity of the heterogeneous conglomerate, coal, can be appreciated if it is considered that it represents the accumulation of vast masses of a large variety of vegetable materials under different climatic and topographical conditions, and their gradual metamorphosis by biological, chemical and physical agencies extending over geological periods which have proceeded to, or are arrested at, varying stages of development The component portions of a single plant differ widely in their morphological and phytological characteristics and more especially in their chemical composition, that is to say, in the general quantitative relationship of the cellulosic, lignitic, resinic groupings and their quota of normal inorganic plant constituents and accessories, and likewise in the qualitative properties of each of them Assume this mixtum compositum of raw materials to be subjected to bacterial, enzymatic and chemical decay under varying conditions of wind and water, oxidation, dehydration and carbonisation, rest and disturbance, pressure of superimposed strata and disruptive earth movements, let these phenomena occur in different sequence, at different stages of 'coalification' and with different potency in each region, and you will sympathise with the researcher who attempts to piece the jig-saw puzzle of coal constitution together He is faced with complexity in the smallest fragment examined under the microscope or by chemical analysis, in any lump taken from the domestic scuttle, when surveying a coal seam throughout its depth and along its bedding plane or a series of seams overlying each other in a single coal pit, when comparing the commercial products of any district or the deposits of the coalfields in different countries and continents

Such considerations will demonstrate the difficulty of fitting the many hundreds of more or less definite forms in which coal occurs and their transitional modifications into a rigid system of classification Moreover, classification is required for many purposes The geologist, the palæobotanist, the chemist, the combustion or carbonisation engineer, the coal miner, and the coal salesman will all view the problem from their particular point of view, and will insist that any methodical grouping shall give the special information that satisfies their own curiosity or is helpful in their limited sphere of activity

The older classifications of Karsten (1826), Regnault (1832), Gruner (1873), Hilt (1873), Schondorff (1875), and others were originally based on the character, and later the yield, of the coke obtained in the crucible test, and on the length of flame of the burning coal This method has persisted on the Continent ever since, for commercial purposes, though admittedly deficient unless supplemented by other data Attempts at correlating various properties led to the adoption of the ratio of 'fixed carbon' to volatile matter, the 'fuel-ratio', as a standard of comparison, particularly in America In 1900, C A Seyler proposed a classification on the basis of the carbon/hydrogen ratio, and elaborated his scheme in recent years by incorporating the graphical representation of Ralston's isovols and isocals, and applying Parr's correction for mineral matter content Seyler's classification is capable of expansion by plotting other characteristics, such as caking and agglutinating power, oxidisability, oxygen requirement on combustion, hardness and liability to 'slacking' or weathering He visualises an atlas of the coals of the world in which the carbon and hydrogen axes correspond to longitude and latitude and the iso-functional lines to altitude, isotherms and other features of an atlas of physical geography

All attempts at coal classification prior to 1919 had dealt with commercial coals, that is, the mixed product of collieries in certain localities or at best the fuel extracted from individual seams The values used in drawing up coal charts were obtained by unstandardised methods of analysis, often of doubtful definition or accuracy, whilst the materials examined represented average samples, in most cases containing an undue percentage of adventitious mineral matter apart from the 'inherent' ash

In that year Dr Marie C Stopes described in the *Proceedings of the Royal Society* the four visible ingredients of banded bituminous coal—fusain, durain, clarain and vitrain—isolated mechanically from hand specimens from Hamstead Colliery in Staffordshire Reference had been made frequently in the literature to the banding of coal, to the dull (matt) and bright (glanz) nature of the laminations, and to the peculiar lenticular inclusions of mineral charcoal (mother-of-coal) This paper constituted the first attempt to consider coal in detail from a petrological point of view The possibility thus shown, of isolating distinct and identifiable components from any lump of banded coal, has proved a most fruitful factor in the furtherance of coal research during the past fifteen years, and its significance has penetrated even into the realm of industry The isolated components were shown to be different and typical in their chemical composition and morphological structure, to be associated with mineral matter in characteristic amount and composition, to have different coking values and to contain groups of organic compounds and plant residues in defined ratios

The subdivision of coal into the four visible Stopes ingredients has been widely accepted in Great Britain and in most European countries American workers have not felt able to adopt it in its entirety, owing partly to differences in the character of their coals and partly to difficulties in terminology They are adhering to the subdivision into Thiessen's anthraxylon and attritus, roughly comparable to clarain-vitrain and durain respectively. The fact that vitrain, clarain, durain and fusain are group designations and were put forward by Dr Stopes as merely representing portions of hand specimens distinguishable macroscopically has not been sufficiently appreciated by subsequent authors ; hence new observations on other coals have in some cases been interpreted as contradicting the original descriptions.

In a recent paper 'On the Petrology of banded Bituminous Coal'[1] Dr Stopes re-states her case and sums up the results of research arising from her original paper She goes further than that, encouraged by the additional knowledge obtained since its publication and in order to clarify the position, Dr Stopes proposes a much more comprehensive, though perhaps more ambitious, scheme of classification The new schedule[2], which during the last two years has been discussed in detail by the British and American members of the Coal Research Club and others, provides for the further subdivision of the macroscopic components into smaller groups, to which the generic term 'macerals' has been given, analogous to the minerals composing a rock These are connotated by the suffix *-inite* A maceral is named generally according to the kind of tissue from which it is mainly derived and of which in its mummified form the bulk of the unit consists If wood, cork, cortex, cuticles, spore exines or resin was the raw material, the maceral is called xylinite, suberinite, periblinite, cutinite, exinite or resinite respectively Completely jellified plant material is ulminite, whilst re-precipitated ulmin compounds form collinite Fusainised xylem or other lignified tissues are fusinite and the yet little explored matrix of durain or 'residuum' is termed micronite The combination of individual macerals present in the hand specimen (having suffix *-ain*) are vitrinite, fusinite, clarinite and durinite

In order to allow for the distinction between vitrains with and without structure, Potonié's terms pro-vitrain for the former and eu-vitrain for the latter are adopted, and in the case of vitrain the sub-groups ulmain, collain, periblain, suberain and xylain have been interposed between the main component and its macerals, to denote their principal characteristics

The schedule may at first glance appear complicated, and some may gibe at the mass-production of new terms These are, however, not meaningless words, but signify distinct elements which have been recognised and defined by the microscopist and the chemist Whilst the technique of identification and isolation of macerals has yet to be developed, the schedule forms a well thought out skeleton into which existing knowledge and future observations can be fitted The scheme is obviously of a tentative nature and mainly intended for the bituminous portion of the coal range, and not so much for coals of lower rank (peat, brown coal, lignite), but its potential bearing on coal research and practical coal classification should not be underrated

Classification hitherto had to be applied to complex mixtures It could be based with advantage even to-day on the characteristics of the main components of coal If, however, in future by the combination of petrological and analytical data, the physical and chemical properties of the small units of the coal complex can be ascertained, the composite value of the fuel will be assessed with much greater accuracy than is possible at present What may, therefore, appear to-day as a somewhat academic problem, may to-morrow have a very definite effect on practical coal politics The coal producer, knowing that he can only sell the coal which he happens to find in his pit, usually stands aloof from attempts to codify coals in anything but a 'use' classification In Great Britain, even schemes for grading coal by size and freedom from ash and moisture have so far been regarded with disfavour The modern requirements of the industrial consumer, however, make more rigorous demands on the properties of coal used in his processes and indicate the necessity of defining these in terms different from the nondescript 'Derby Brights' beloved by the British householder in the past

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[1] Fuel in Science and Practice", Jan 1935, 14 4 13

[2] Copies can be obtained from Dr M C Stopes, Norbury Park, nr Dorking, England

Obituary

PROF GANESH PRASAD

WE regret to announce that Prof Ganesh Prasad died on March 9, with unexpected suddenness Born in Ballia, a small town in the United Provinces, India, on November 15, 1876, Prasad took the D Sc degree of the University of Allahabad at the age of twenty-two years, and then studied at Cambridge and Göttingen as a Government of India scholar After serving for ten years as a professor of mathematics in his native province on his return from Europe, in 1914 he joined the University of Calcutta as the Ghosh professor of applied mathematics He left this post four years later to join the Benares Hindu University as its University professor, but came back to Calcutta in 1923, this time as the Hardinge professor of pure mathematics, which post he occupied until the time of his death While he was in the Benares Hindu University, he was also the principal of the Arts and Science College for about two years.

Prof Prasad was the first in India to create a school of mathematical research Many of the papers on mathematics published by young Indian investigators in the last twenty years bear an acknowledgment of indebtedness to him for guidance and help He founded the Benares Mathematical Society in 1918, and was its life-president. He had been for many years the president also of the Calcutta Mathematical Society

One of the earliest contributions made by Prof Prasad was his dissertation entitled "The Constitution of Matter and Analytical Theories of Heat" (1903), in which he dealt with the difficulty of interpreting differential coefficients when the molecular constitution of matter is taken into account. His papers on applied mathematics, published in various journals, dealt likewise with problems in which he skilfully applied his knowledge of the theory of functions of a real variable to potential problems in which the differential coefficients became infinite or did not exist. His later researches were on the theory of Fourier series and other branches of the theory of functions of a real variable. At the time of his death he had in hand the completion of a long memoir on "The Expansion of Zero", which he had promised to contribute to the first issue of the journal of the newly created National Institute of Sciences, India, of which he was a member of council

Prof Prasad was well known as a teacher, and his textbooks on the differential and integral calculus are still in use in many Indian universities His Patna University readership lectures on "The Place of Partial Differential Equations in Mathematical Physics" were published in 1924, and since 1928 he had devoted a good deal of his time to the writing of books on higher mathematics and on the history of the subject

Prof Prasad was much loved and admired by his numerous pupils, to whom he was always a source of great inspiration He was a man of wonderfully simple habits, and remarkable energy and powers of endurance He had a marvellous memory When he was a principal- to mention but one example— he recognised all the students (more than one thousand in number) and remembered not only their names but also numerous details about them

GORAKH PRASAD

DR. SHEPHERD DAWSON

BY the death of Dr Shepherd Dawson on March 26 at a relatively early age, experimental psychology in Great Britain has suffered a great loss For a period of many years, his experimental contributions have been published in the technical journals (mostly in the *British Journal of Psychology*) All have been marked by careful attention to the requirements of scientific method In later years his attention was directed towards the statistical problems of psychology, and a few years ago he published a book on statistics

Shepherd Dawson's earliest published work on various problems of vision already showed his quality as an accurate and painstaking experimentalist After he succeeded H J Watt as principal lecturer in psychology, logic and ethics at Jordanhill Training College, Glasgow, he did not lose his interest in experimental research. At meetings of the British Association he had generally some original investigation to report. Probably the best known of his later contributions to experimental psychology was his work on "Persistence" carried out in collaboration with Prof. E. P. Cathcart. He had a real liking for apparatus, and few years passed during which he did not demonstrate at the meetings of the Scottish branch of the British Psychological Society (of which he was, at one time, president) some ingenious piece of apparatus which he had devised for practical work at Jordanhill. He was closely associated with the work of Conn on the effects of encephalitis lethargica on intellectual development.

When, last year, Shepherd Dawson became president of Section J (Psychology) of the British Association, he chose characteristically a subject both more scientific and more practical than that of most of his immediate predecessors, namely, "Psychology and Social Problems", in which he dealt with such urgent practical problems as the negative correlation between intelligence and fertility.

Shepherd Dawson's interests lay almost entirely in the measurable aspects of psychology and not in introspective investigation or in theoretical psychology. Within this field of the measurable, his interests were wide. His own investigations were of a very varied nature, and he was widely interested in the work of others. He was generous in his gift of time and thought to all who asked his advice. All who knew him will mourn his untimely end.

R. H. T.

SIR GEORGE SCOTT, K.C.I.E.

WE regret to record the death on April 4, at the age of eighty-three years, of Sir James George Scott. Sir George Scott was well-known as an administrator in Burma, more especially for his success in dealing with the less-advanced tribes, concerning whom his writings are the best, and in some instances the only, authority.

James George Scott, the second son of the Rev. George Scott of Dairsie, Fife, was born on December 25, 1851. He was educated in Germany and at University College School, London, the University of Edinburgh, and Lincoln College, Oxford. He went to Perak as a war correspondent in 1875, and in 1879 joined the staff of St. John's College, Rangoon, where through contact with his pupils he laid the foundations of that knowledge of, and affection for, the peoples of Burma, which became the ruling force of his later life. After witnessing French operations in Tonking as a correspondent of *The Times* in 1884, he served in a political capacity with the British expedition to Upper Burma and later joined the Government service as an Assistant Commissioner. In 1887–88 he was employed in the Shan States and assisted in the pacification of the rebellious Shans.

After serving on the Anglo-Siamese Boundary Commission in 1889–90, Scott was made superintendent of the Northern Shan States, and by his courage and personality made effective British influence over wild tribes who hitherto had been irreconcilable. From this time onward his career was a succession of difficult and responsible positions, each of which was in a sense a recognition of his previous success by promotion to a more difficult undertaking. Among these were service on the commissions which settled the Franco-Burmese and the Siamo-Burmese boundaries. His knowledge of the Burmese peoples was put to good use when he was made responsible for the five volumes dealing with Upper Burma in the Census of 1901. He was made a K.C.I.E. in 1901, having been a Companion of the Order since 1892. In the following year Scott became Political Agent and Superintendent of the Southern Shan States and remained in that office until he retired in 1910. After his retirement his leisure was occupied in writing.

Scott was a ready and versatile author. His publications in book form began so long ago as 1882 with two volumes entitled "The Burman: His Life and Notions" published under a Burmese pseudonym, while the first book to appear under his own name was "France and Tonking", published in 1885. Among his other works, apart from a number of novels, may be mentioned "Burma as it was, as it is, and as it will be" (1886), "Burma, a Handbook of Practical Information" (1906), a comprehensive account in which he was assisted by experts, "The Mythology of Indo China" (1918), "Burma from the earliest Times to the Present Day" (1924) and "Burma and Beyond" (1932), in which he recast and supplemented much of the information relating to tribes on the fringe of the British sphere of influence in his earlier works. He was also a contributor to Hastings' "Encyclopædia of Religion and Ethics" and various scientific periodicals.

PROF. W. J. SINCLAIR

PROF. WILLIAM JOHN SINCLAIR, who died at Princeton, New Jersey, on March 25, made many important contributions to our knowledge of fossil vertebrates, and added much to the palæontological museum of Princeton University, of which he had been director since 1927. He was born at San Francisco on May 13, 1877, and received his Ph.D. from the University of California in 1904. He removed to Princeton in 1905, became assistant professor in 1916, and was appointed professor of palæozoology in 1930.

Prof. Sinclair was specially interested in fossil mammals, and his most noteworthy work was his memoir on the fossil marsupials of Patagonia, published in 1906 in the reports on the Princeton University Expeditions to Patagonia, 1886–99. He concluded that the close resemblance between the Patagonian fossil Sparassodonts and the living Tasmanian Thylacine could only be explained by a former land connexion between South America and the Australian region.

WE regret to announce the following deaths:

Sir John Collie, chief medical officer of the Metropolitan Water Board, known for his work on the psychology of fraud, on April 4, aged seventy-four years.

Colonel W. G. King, C.I.E., distinguished for his work in connexion with public health in India, on April 4, aged eighty-three years.

News and Views

The Formosa Earthquake

ON April 21, at 6.2 a.m. (local time), the most destructive of recorded earthquakes in Formosa devastated the two north-west provinces of Taichu and Shinchiku. According to the latest official figures, 3,152 persons were killed and 8,991 injured, while 19,217 houses were destroyed and 18,472 damaged. In the great earthquake of March 17, 1906, the corresponding numbers were 1,249, 2,378, 5,667 and 3,233. According to the Tokyo correspondent of *The Times* (April 22), the centre of the earthquake was in the upper reaches of the Koryuki river, the area of greatest damage being 50 miles long and 25 miles wide. The focus is placed by the Japanese seismologists as near the surface at a point 25 miles north-east of Taichu. At Taiho, fires broke out after the earthquake, and it is feared that the town will be completely destroyed. Taichu suffered less, only about a hundred of 50,000 inhabitants being killed. Thus, the area chiefly affected runs from Taichu along a line parallel to the coast, but stopping short of Taihoku. It is of some interest to note that this great shock occurred in a district in which earthquakes have been infrequent during the present century. The principal zones are those in the districts of Kagi in central Formosa, and Karenko and Giran on the east coast. To the Kagi centre belonged the earthquake of 1906 during which the crust was dislocated along a fault about 30 miles in length. According to Omori (*Imp. Earthq. Inv. Com. Bull.*, 1, 53–72, 1907), the displacement seems to have been unique. In the western half, the ground on the north side was sheared relatively eastward and depressed, while, in the eastern half, the south side was sheared westward and depressed.

Rural Water Supplies in Great Britain

THE subject of national water supplies again came up in the House of Commons on April 20 when on the motion for the adjournment Mr. A. Greenwood raised the question of the expenditure incurred by authorities in rural areas on the provision of new supplies, and inquired the Government's intentions in regard to the Water Supply (Exceptional Shortage Orders) Act which will lapse at the end of the present year unless steps are taken to extend it. Mr. Alan Chorlton expressed regret that the water survey which at long last has been agreed to does not extend to allocation, and asked what steps are being taken within the Ministry of Health to set up a central body as advocated in the report of the water authorities. Mr. G. H. Shakespeare, Parliamentary Secretary to the Ministry of Health, in reply, gave no indication whether a continuance of the emergency legislation will be necessary, but stated that the grant of one million pounds voted in aid of rural schemes last year has fostered the promotion of schemes estimated to cost three times that amount and is expected to do as much again during the current year. Out of just over 2,000 parishes requiring permanent sources of supply, schemes for 1,600 parishes have been prepared and are in various stages of realisation. He alluded to the recently formed Water Survey Committee, and stated that two meetings have been held and that the Committee is actively pursuing its inquiries into the actual water supplies of the country.

Award to Sir Aurel Stein

IT is announced that the gold medal of the Society of Antiquaries of London has been awarded to Sir Aurel Stein. The services to archæology of Sir Aurel Stein, which are thus recognised by what may be regarded as the highest award in Great Britain for archæological studies, are too well known to need recapitulation. His journeys in the Central Asiatic desert, and his excavations among its sand buried cities, pursued almost without intermission for more than thirty years at a cost of great personal hardship borne with never-failing endurance, have rewritten a long chapter in the history of Asiatic civilisation which had been lost, and brought to light the unsuspected glories of an art which had grown out of the otherwise unrecorded contacts of the classical world and India with the Far East. His explorations of the lands of the North-West Frontier of India, among other discoveries, have retraced the march of Alexander the Great and illuminated the course of one of the great campaigns of world history. While regret is universal that a nationalist policy in China should have put an end to Sir Aurel's investigation of the great complex of mountain and desert of Central Asia, by which he was unravelling the causes which led to the decay of this arena of a great civilisation, by diverting his activities to other fields, it may, should his hopes of discovery in Persia be realised, add still further to the indebtedness of archæological knowledge to his genius in exploration.

Indian Art in Great Britain

IT is not surprising, in view of the long and intimate connexion of Great Britain and India, to learn that a search has revealed a number of examples of Indian art in public and private collections in Great Britain, which in the aggregate and in artistic quality and historic interest is impressive. In the last few months, Dr. K. N. Sita Ram, curator of the Central Museum, Lahore, according to a note in *The Times* of April 20, has been engaged in a comprehensive survey of the examples of Indian art and archæology in museums and art galleries throughout the British Isles. After identifying and cataloguing the Buddhist sculptures from Amravati in the British Museum, at the suggestion and with the cooperation of the Museums Association he has examined some fifty collections, travelling so far afield as Elgin, Dublin and Belfast. Not only did he assist in rearranging and relabelling these collections, but he also advised on spurious or indifferent specimens, and in a number of instances discovered treasures which had been overlooked or of which the interest had been unrecognised As a result of his inspection, choice specimens from private collections in several instances have now been placed in local museums Among the rarer and more unexpected of his finds are examples of Buddhist sculpture from Java at Edinburgh, Dublin, Elgin and Hawick, fine paintings of the Rajput, Kangra, and Moghul Schools at Halifax, Manchester and Edinburgh, and sculptures of the great Gandhara period and South Indian bronzes in many collections Dr Sita Ram, it is stated, is confident that without unduly depleting local collections, it is possible to get together ample material from Java and India now in the British Isles to provide for the central museum of Asiatic art and antiquities, which those who are interested in British national collections are convinced is an urgent need of the present time

Calendar Reform

THE International Fixed Calendar League, 1 Regent Street, London, S W 1, has issued a topical pamphlet entitled "How to Fix Easter and Establish Calendar Reform" The arguments for and against calendar reform bear some resemblance to the movement in favour of a 24 hour time system, which met with little encouragement from the public when it was given a trial by the B B C last year There is little solid, compelling argument in favour of either, though it would be a convenience in the long run to rationalise our methods of reckoning the hours of the clock and the days of the year It is claimed that the fixation of Easter would result in great public convenience, and that the equalisation of the number of days in each month, and in each quarter, would simplify statistics based on monthly and quarterly returns There are two rival schemes for calendar reform In the first there are twelve months, each quarter containing 31 + 30 + 30 days, and in the second thirteen months, each of 28 days. The stabilisation of the week and the month is to be obtained in either scheme by counting the 365th day in an ordinary year as Year Day, and by counting the 366th day in a Leap Year as Leap Day, neither day having a place in any week The International Fixed Calendar League casts a shadow on the respectability and balance of its arguments by exhibiting an intemperate preference for the 13 month plan as compared with the 12 month plan, it is claimed, for example, that the 13 month plan "would help research in science, health, etc" but that the 12-month plan would not ! It is extremely interesting to compare Pamphlet *E* for general consumption, with Leaflet *L*, "Fixed Calendar Benefits for Labour" (which was not sent to NATURE Office), in which the League indulges in an attempt to enlist the sympathies of the Labour movement in its scheme for calendar reform

Geographical Distribution of Unemployment

IN the issue of *Planning* dated March 26 (16 Queen Anne's Gate, London, S.W.1) some important facts relating to the geographical distribution of unemployment are emphasised with the aid of a diagram, wherein Great Britain is divided into two halves The first half, consisting of the Midlands, South and South West England, contains 6,319,000 insured persons between the ages of 16 and 64 years, while the second half, consisting of North England, Scotland and Wales, contains almost the same number, namely, 6,221,000 Yet the first half has less than 650,000 claimants to unemployment benefit and assistance, while the second half has nearly 1,300,000, or more than two thirds of the total registered unemployed If the comparison is confined to claimants for transitional payments and allowances—that is, to the able bodied unemployed coming under the Unemployment Assistance Board—the contrast is far more striking Less than a quarter of these cases occur in the first or more prosperous half and more than three quarters in the depressed half. Moreover, as there are large areas which are fairly prosperous even in the second half, the real concentration of the problem of able bodied unemployment for long spells is far narrower than regional figures show Another striking fact brought out is the relative insignificance of protracted unemployment among women workers

Printing by Wireless

ACCORDING to a report in *The Times* of April 20, a new instrument for wireless telegraphy, which will either handle the morse code or transmit and receive messages in plain letters, has recently been produced by Messrs Siemens and Halske of Germany, and is being demonstrated at the London offices of Messrs Siemens-Schuckert The instrument can be operated by any ordinary wireless set with an output of one or two watts, the frequency of the output signal being adjusted to be 900 cycles per second The mechanism consists of a short roller with a two-turn spiral or helix rotating over a paper tape and carbon paper, which are fed underneath On the arrival of a signal, paper and carbon are lifted sharply up against the helix by a blunt knife edge and, depending upon the duration of the blow, either a line or dot is printed The duration of the dot is about 1/500 of a second, while the system is capable of passing messages at a speed of about 50 words per minute No very elaborate means of synchronism between transmitter and receiver is required, and the apparatus is almost entirely free from atmospheric and other forms of electrical interference This new radio-telegraph printer is intended primarily for use in conditions where line-telegraphy is not possible, or where interference makes other methods of communication impossible At a demonstration in London, signals were received from the Königswusterhausen Station in Germany, using 8 kilowatts and sending out its ordinary service of news

Science in Everyday Life and the Schools

THE British Science Guild has recently organised a series of lectures on science which are intended to bring before the pupils of secondary schools some of the remarkable advances in scientific knowledge and in its applications to everyday life which are being made at the present time. The first two lectures were delivered in March to girls from London secondary schools by Mr. C. C. Paterson, director of the Research Laboratories of the General Electric Co., Ltd., Wembley, and have now been issued by the Guild as a pamphlet (Pp. 20. 1s.) entitled "The Electron Liberated; its Industrial Consequences". They deal with the emission of electrons from hot and illuminated surfaces and the uses made of them in modern electrical engineering, in particular in the production of light. The mysterious dual character of the electron as a missile and a group of waves is not forgotten, and the necessity for more and better knowledge of its properties is insisted on. The Guild is to be congratulated on the inaugural lecturer, to whom thousands of electrical engineers listened with such pleasure on the subject last year. The sooner other schools can have the benefit of lectures of this type, the better it will be for our future citizens.

Industrial Administration, at Loughborough College

FACILITIES for training in industrial administration and management are now increasing in Great Britain, the latest development being that at Loughborough College, where a Department of Industrial Administration was inaugurated last year. The courses provided are of an intensive nature, extending over short periods, and the aim is to provide a kind of staff college for industry where executives may be given an insight into a larger range of administrative practice than they would be likely to obtain in the ordinary way. The scope of the new department is thus somewhat different from those now well established at the Manchester College of Technology, or the London School of Economics, which provide courses extending over one or two academic years. The facilities provided at Loughborough include week-end, ten day and longer courses adapted to the degree of experience of those attending. Instruction includes lectures, organised reading, group discussions, personal discussion of individual problems and visits to works and offices. It is intended that the week-end courses should be confined to executives with practical experience in the same industry, and in the first instance, these are being provided for engineering executives and will deal with such special topics as costing, rate-fixing and progress control. In the prospectus of the Department, it is pointed out that the various courses are of especial value to owner-managers who have not been able to acquire experience in other businesses, and to executives whose experience has been confined to a restricted field.

Meteorology of the South Seas

APIA OBSERVATORY, in Western Samoa, is under the control of the Department of Scientific and Industrial Research, New Zealand, and the work is directed by Mr. J. Wadsworth, formerly in the Meteorological Office, Air Ministry, who has recently presented his report for 1932 to the Observatory Board in the form of a compact and very clearly printed little volume of 114 pages. The report is a summary of observations in terrestrial magnetism, seismology, meteorology and atmospheric electricity. Synoptic weather charts were made on every day of the year, the data being collected by the wireless station at Apia from twenty observing stations in other groups of islands in the South Pacific, and sometimes from passing ships. Since May 1932 a daily weather report has been exhibited at the Post Office and Customs House in Apia, at the request of local shipowners. Considering the small size of the staff, which consists of the director and two scientific assistants and four locally recruited clerks, the amount of work accomplished, especially on the purely meteorological side, seems highly satisfactory. Upper winds were measured with the aid of pilot balloons on seventy-eight occasions, the usual meteorological instruments were maintained, while in addition a Piché evaporimeter and a Wilson radio integrator were read daily at 9 a.m. The meteorological summaries are so detailed that a very clear idea can be formed of the weather experienced from day to day in this part of the South Seas; they include, also, less detailed climatological summaries from other groups of islands. An even fuller programme was contemplated, for arrangements were being made for re-conditioning and bringing into use a spectrohelioscope which was obtained on loan from Mount Wilson Observatory.

Standardisation of Insecticides and Fungicides

THE standardisation of insecticides and fungicides has for some years been a matter of discussion among both the users and manufacturers of these chemicals, and requests from farmers and growers that the content of active materials in these products should be guaranteed resulted in the publication by the Ministry of Agriculture of specifications of a number of those most generally in use (Advisory Leaflet No. 9). To meet the recent great development in the employment of insecticides and fungicides, a further publication has now been issued by the Ministry, namely, Bulletin 82, "Specifications and Methods of Analysis for Certain Insecticides and Fungicides" (London: H.M. Stationery Office. 3*d*. net). In this bulletin, the specifications already published have been brought up to date, and additional specifications for certain compounds such as copper fungicides, not previously dealt with, have been included. In addition, agreed methods of analysis, drawn up in connexion with the specifications, are supplied. Both specifications and analytical methods have been accepted by the Association of British Insecticide Manufacturers, the Government Laboratory, the National Farmer's Union and the Ministry of Agriculture. Purchasers are strongly advised to require a guarantee that materials supplied comply with these specifications, for, by so doing, they ensure that they obtain standard products of high quality.

Lancashire Sea-Fisheries Research

THE report for 1932 (No. 41) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool (1933), edited by Dr. R. J. Daniel, is in future to be incorporated with the *Proceedings and Transactions of the Liverpool Biological Society* and not issued separately. The present report includes accounts of experimental lobster rearing by W. C. Smith, plaice marking in the Irish Sea by R. J. Daniel and R. A. Fleming, and a comparative study of the abdominal musculature in Malacostraca (Part III) by R. J. Daniel. This last paper is a continuation of Dr. Daniel's work on the muscles of various Crustacea which have been published in the Lancashire Sea-Fisheries Reports in 1927, 1929 and 1932, and describes the musculature of *Lophogaster typicus* and *Gnathophausia zoea*. The weight of evidence shows a close affinity between the Euphausiacea and the lower decapods, although there are apparent similarities between *Meganyctiphanes* on one hand and *Lophogaster*, *Gnathophausia* and *Praunus* on the other. It is concluded by the author, after very careful consideration, that the former represents a true relationship (homology) and that similarities between mysids and euphausids are due to convergence. These researches on the abdominal muscles are carefully and beautifully worked out and are accompanied by fine drawings.

Welfare Problems in India

IMPENDING constitutional changes, which will affect welfare administration in India, add particular significance to two articles by Mr. Cedric Dover in the January issues of *Mother and Child* and the *Quarterly Review*. He discusses the organisation and condition of maternal and child welfare in India, and the needs and defects of welfare legislation. Maternal mortality rates are 4–20 times, and infant mortality rates 3–4 times as much as the averages obtaining in England, and are closely correlated with communal prosperity and housing conditions. An interesting biological correlation is that between climatic conditions and frequency of conceptions, the maximum number occurring in Bombay during the period of minimum humidity (January–April). Both articles emphasise the need for centralisation and greater co-ordination of welfare activities. A consolidated Public Health Act for all India is regarded as the primary essential of welfare legislation, and a commission on legal reform is suggested, which will recognise that "the main object of law is the prevention of dysgenic, and the encouragement and establishment of eugenic forces", unimpeded by traditional beliefs. The operation of Hindu, Mohammedan and Christian laws under one administration is dismissed as "an anachronism that needs no emphasis".

Commercial Timbers of the Punjab

A Forest Bulletin, No. 84, in the Economy Series of the Imperial Forest Research Institute, Dehra Dun, has been recently issued (Delhi: Manager of Publications, 1934) entitled the "Identification of the Commercial Timbers of the Punjab" by K. A. Chowdhury, wood technologist. The Indian Research Institute has been a pioneer in getting together information on the timbers of a definite region, having undertaken intensive research in the timber resources of India during the past twenty years; with the result that the number of timbers now sold in the market is much greater than it was a few years ago. This fact, states the author, has resulted in difficulties in identification of some of the species which have now come upon the market. The aim of the Bulletin, and a predecessor on Burma timbers, is primarily to show the differences of the anatomical structure of some of the more commercial timbers of the Punjab, and the way to identify them on the spot with the assistance only of a hand lens and pocket knife. Brief notes are also given on the strengths, seasoning properties, durability, working qualities and uses for each species; these latter add greatly to the practical value of the publication. The commercial woods of the Punjab, of which a proportion are temperate species, both conifer and broad-leaved species, are comparatively few in number and their identification is by no means difficult. Those who make use of this Bulletin will find the excellent low power (× 10) photomicrographs of considerable assistance. The species dealt with include the Himalayan conifers, deodar, spruce and silver firs, several pines and broad-leaved trees such as walnut, several oaks, boxwood, poplar and alder, and the Plains species, such as sál, mango, tun, sissoo, tamarix and so forth.

Chemical Research in Czechoslovakia

UNINFLUENCED by the economic depression, which has been felt in Central Europe as keenly as elsewhere, the various schools of chemical research in Czechoslovakia have continued their activities with undiminished energy, as is apparent from the papers published in vol. 6 of the *Collection of Czechoslovak Chemical Communications*. In inorganic chemistry, Dr. Škramovsky's 'stathmographic apparatus' has found further application in the study of complex inorganic salts such as the bismuth oxalates. The apparatus automatically records photographically the change in weight of a substance with, for example, increasing temperature. Striking dehydration curves have been obtained and results are found to vary according to well-defined circumstances. Thus copper sulphate crystals from aqueous solutions show quite different behaviour from those from alcoholic solutions. Further, inoculation with lower hydrated salt causes characteristic changes in the curves photographically recorded. The stathmographic method thus seems to promise a new field of investigation in inorganic chemistry. In physical chemistry, the Prague polarographic school has published further work especially in connexion with the catalytic evolution of hydrogen at the dropping mercury cathode, which can be made use of in micro-analytical tests. Revenda's work in Prof. Heyrovský's laboratory has extended the applicability of polarographic analysis to the anions. In organic chemistry, the *Collection* includes results of researches by Prof. Votoček and his collaborators on new conversions of sugars to furane compounds. New glucosyl-alkyl-amines are described, and the constitution of fuco-hexonic and rhodeo-hexonic acids has been worked out.

American Geophysical Union

THE American Geophysical Union, established in 1919 as the American National Committee of the International Union for Geodesy and Geophysics, held its annual congress this year at Washington, on April 26–28, and one of its sections met again at Berkeley, California, on June 20–21 All the seven sections of the Union, for geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, and hydrology, met at Washington Only the hydrology section was represented at Berkeley, where its meetings were associated with the Western Inter-State Snow Survey Conference The report of the Union is this year published in two volumes (reproduced direct from typescript, as in recent years), of which the first, of 257 pages, relates to the General Assembly and the first six sections; the second volume is still larger, of 370 pages, and forms a striking illustration of the attention now being devoted in the United States to the many aspects of hydrology—a subject almost neglected in Great Britain. The volumes contain very many short scientific papers of great interest, as well as formal reports on work in progress

Mining Research at Birmingham

WE have received the report of the work of the Mining Research Laboratory in the University of Birmingham during the year 1933, which has again been financed by the British Colliery Owners' Research Association and by the Miners' Welfare Fund This executive board of mining research is doing excellent work under the chairmanship of Dr J. S Haldane Again this year silicosis is investigated, but in accordance with Dr. Haldane's repeatedly expressed opinions, the work appears to be confined to the determination of 'free' silica; Dr W Jones's investigations are not referred to Nystagmus, which was carefully investigated previously, is not specially discussed, although the investigation of underground illumination no doubt will play a very important part in minimising the incidence of this distressing and costly complaint. Much appears to have been done with regard to the production of gas of high calorific power from coal or coke oven gas, and various investigations tending to improve atmospheric conditions underground as well as investigations into the physiology of the miner will no doubt prove of great value in the future

Calculations for Draughtsmen

THE Association of Engineering and Shipbuilding Draughtsmen has recently added to its useful series of pamphlets one on "Some Notes on Deflection", by Mr. W. R. Thomson, and another on "Mechanical Design of High-Speed Salient-Pole A.C. Rotors", by W. R Needham. In the first of these the author gives a logical account of the principles of deflection of cantilevers and simply supported beams. No advanced mathematics is used, rough sketches being sufficient to give the figures necessary for the deflection calculations, which are made by slide rule. In the second pamphlet, Mr. Needham deals with shafts and bearings, shaft stresses, critical speeds, rotor bodies, rotor poles, coil supports and balancing. The stresses in high-speed rotors are of a very high order, and the centrifugal force of a single pole and coil, says the author, at the overspeed may exceed a million and a half pounds. The overspeed in some hydro-electric machines may exceed the normal by as much as 100 per cent

Bibliography of Seismology

A NEW volume (No 12) of the Publications of the Dominion Observatory (Ottawa) is, we are informed, to be devoted to the bibliography of seismology. The first part, issued recently, contains notices of memoirs for the first quarter of the present year It may be noted that vol 10 of the Publications includes the titles of 2,000 memoirs for the years 1929–33 A still earlier series, in which notices of 1,200 memoirs appeared, was issued under the auspices of the Eastern Section of the Seismological Society of America and was published in vol 17–19 of the *Bulletin* of the Society Both series were prepared by the present editor, Mr E A Hodgson, who has now the assistance of twenty-four collaborators All the important countries in which earthquakes are studied are represented on this list, with the exception, we regret to notice, of Great Britain

Diseases of Swedes

A NEW bulletin (No 74) issued by the Ministry of Agriculture (H M. Stationery Office, 1*s*) is concerned with two diseases of swedes. Experiments with pure culture have shown that canker, which affects the seed-bearing plant, and dry rot which attacks the roots, are both due to the same fungus, *Phoma Lingam.* This fact is of importance, as infected seed would be likely to result in an infected root crop The disease is not serious in England, but has become prevalent in New Zealand; and since most of the seed used there is obtained from Great Britain the question of infection is important. Methods of seed sterilisation have been sought with no great success, but evidence has been obtained that weeds afford a serious source of infection. Good cultivation would, therefore, seem as necessary as clean seed if spread of the infection is to be avoided.

Population Problems

THE third General Assembly of the International Union for the Scientific Investigation of Population Problems will be held in Berlin on September 9, at 11 a.m., in the rooms of the University. An International Congress will be held in Berlin on September 10–15 under the auspices of the International Union. The Congress will have the following divisions: (1) Population Statistics; (2) Biology and Race Hygiene; (3) Social, Economic and Psychological Problems of Population; (4) Medicine and Hygiene. The business office of the Congress is, Berlin W 62, Einemstrasse 11.

Congress of Anthropology

THE sixteenth Congress of Anthropology and Prehistoric Archæology will be held at Brussels from

September 1–8. It will consist of the following sections: morphological and functional anthropology, blood groups, human palæontology, heredity and selection, psycho sociology, criminal anthropology, ethnography, folk-lore and history of religions. Further information can be obtained from the general secretary, Dr Dekeyser, 9 rue des Sablons, Brussels

The Sky in May

VENUS continues to be a brilliant evening object Both its brilliance and its eastern elongation are still increasing Mars passed through opposition on April 6, and is now an evening object It will be stationary on May 19. The planet is very conspicuous in the southern sky just before midnight Mars has been very close to γ Virginis during the last week in April This star is worth examining with a small telescope as it is a double star which is easily resolved, the two components, whose magnitudes are $3^{m}65$ and $3^{m}68$, being six seconds of arc apart. Jupiter is in opposition on May 10. The planet is rather far south of the equator Saturn is still a morning object. The moon will occult the bright star δ Geminorum on May 7 Both disappearance and reappearance will be visible at Greenwich, taking place at $21^{h}59^{m}$ and $22^{h}56^{m}$ G M T. respectively

Announcements

PROF. A. C SEWARD, professor of botany in the University of Cambridge, has been elected a member of the Norwegian Academy of Science and Letters, and also an honorary fellow of the Indian Academy of Sciences, Bangalore

As a token of their admiration, the friends of Sir Arthur Evans in the Mediterranean have subscribed towards the cost of a portrait-bust of himself to be presented to him in recognition of his pioneer work in the exploration of the Mediterranean bronze age civilisation at Knossos. The presentation took place on April 14 in the Museum at Candia in the presence of a numerous body of friends and admirers.

THE thirteenth award of the Faraday Medal of the Institution of Electrical Engineers will be presented to Dr. F. B. Jewett, of New York, at the ordinary meeting of the Institution to be held on May 2. The presentation will precede the twenty-sixth Kelvin Lecture, which will be delivered by Sir William Bragg, on "The Molecular Structure of Dielectrics".

THE forty-first James Forrest Lecture of the Institution of Civil Engineers will be delivered on May 14 by Prof. O. T. Jones, Woodwardian professor of geology in the University of Cambridge, who will speak on "Geophysics".

THE Royal Geographical Society has made the following awards for 1935: Murchison Grant, to Mr. R. P. Bishop, for his surveys in British Columbia and other services to geography; Back Grant to Mr Wilfred Thesiger, for his journey through the Danakil country, 1933–34, Cuthbert Peek Grant to Mr A R Glen, for his work in Spitsbergen, particularly his leadership of the Oxford University Expedition, 1933, Gill Memorial to Mr E E. Shipton, for his plane-table surveys of the inner Nanda Devi basin and the neighbouring watersheds.

PROF W L BRAGG will deliver the twenty-fifth annual May Lecture to the Institute of Metals on May 8 in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S W 1, at 8 p m The subject of Prof Bragg's lecture will be "Atomic Arrangements in Metals and Alloys" Tickets of admission can be obtained from the Secretary of the Institute of Metals, 36 Victoria Street, London, S W 1

DRS. ACHARD, Lapicque and Mayer of Paris, Policard of Lyons and Bouin and Vlès of Strasbourg have been elected members of the section of biological sciences in the French Superior Council of scientific research, and Drs Martin, director of Institut Pasteur, and Roussy, of the faculty of medicine of Paris, extraordinary members

THE August Forel foundation of the German Academy of Natural Sciences at Halle, which is to award a prize every two years for researches in the subjects in which Forel was specially interested (eugenics, the alcohol problem, study of ants and the central nervous system), has recently made its first award to Dr Graf, who is head of the department of industrial physiology at the Kaiser Wilhelm Institute of Dortmund

AN index to the *Astrophysical Journal* covering the issues of January 1920–June 1932 (vols 51–75) will be published in May It can be obtained, price 2 60 dollars, including postage, from the University of Chicago Press, 5750 Ellis Avenue, Chicago, Illinois.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in zoology in the University of Capetown—The Secretary to the High Commissioner of the Union of South Africa, Trafalgar Square, London, W.C.2 (April 30). A lecturer in the Engineering Department, College of Technology, Leicester—The Registrar (May 4) A junior scientific officer in the Scientific Research Pool, Air Ministry—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 4). A temporary engineering assistant in the Directorate of Works, War Office—The Under-Secretary of State (C 5), The War Office, S.W.1 (May 6). Inspectors in connexion with Agricultural and Horticultural Education and Research under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (May 13). A physicist in the Radium and X-Ray Therapeutic Departments of the General Infirmary, Leeds—The Secretary (May 18). A lecturer in mathematics at the Royal Technical College, Glasgow—The Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 659.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Winter Feeding of the Tick, *Dermacentor andersoni*, Styles

ONE of us (J D G) recently engaged in investigating the feeding habits of ticks at the Dominion Entomological Station at Kamloops, British Columbia, with special reference to the dissemination of disease—at the end of September, 1934, brought to the zoological laboratory at the University of Alberta, Edmonton, a limited number of adults of *Dermacentor andersoni* (native at Kamloops) for winter study In contrast to their behaviour through the summer months, these ticks consistently refused to feed when brought to Edmonton in the autumn Incidentally, one individual placed on a sheep at Kamloops, as early as the beginning of September, had refused to engorge and was finally removed after two weeks This observation appears to agree with the experience of the Rocky Mountain Laboratory at Hamilton, Montana, where thousands of ticks are reared annually

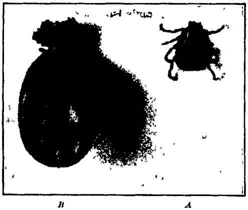

FIG 1 *A* Adult female tick (*D andersoni*) unfed *B* Engorged female, at the commencement of egg-laying, February 10, 1935 × 3

In all, eight adults were used on domestic rabbits and man (J D G.) during November and December, but although willing to attach or to shift their positions and re-attach, none of them attempted to engorge (or if they attempted it, did not succeed) during the six days that constituted the test period in each case.

The ticks being useless for practical purposes whilst behaving like this, it was suggested by the other of us (W. R) that if appropriate modification could be induced in the physiological state of the host, the parasite might exhibit a corresponding change of behaviour upon attachment The scheme of controlled illumination originally used on the *Junco*[1], resulting in the conversion of a sexually dormant autumn individual into a fully sexed spring bird in a few weeks and evidently conducive to profound changes in physiology and metabolism, suggested an obvious method of treatment which was accordingly adopted.

On December 14 a domestic rabbit was provided with a cage in which illumination could be precisely controlled, and for the week following was restricted to a day of seven hours duration On the eighth and subsequent days the period of illumination (ordinary electric light bulbs) was increased by ten minutes daily A month later an adult, unfed tick (which had received no illumination or analogous treatment) was placed on the rabbit It attached almost immediately and was replete at the end of two weeks (The normal summer engorging period for *D andersoni* is nine days) Two more adults were then simultaneously applied but both, unfortunately, were females One of these had failed to feed on man at the end of November but now, after two days of indecisive attachments, began to engorge and was replete on the fifteenth day Eight days after removal it began to lay eggs, inevitably infertile (Fig 1) The second individual changed positions spasmodically for a week, when engorgement ensued

Depletion of the stock of adult ticks permitted the use of only one other This was first placed on an untreated rabbit, on which it remained attached for five days without signs of engorgement. It was then transferred to the illuminated host, caged under an opaque capsule strapped to the skin of the rabbit, with intervening water baths absorbing the heat from the illuminating bulbs It attached itself permanently on the fourth day, when engorgement commenced

An additional supply of newly emerged adult ticks was received from Kamloops on February 18. In view of the fact that by this date the days had been lengthening for two months, three were at once placed on an ordinary stock rabbit. Two attached and began engorging on February 19 The third has failed to engorge to date.

The limited material that has been available would, no doubt, make a lengthy discussion of these results premature The most suggestive points are self-evident They seem to be sufficiently novel, however, to justify publication at this stage and to warrant repetition and expansion in the future.

WILLIAM ROWAN.
JOHN D. GREGSON

University of Alberta,
Edmonton.

March 1.

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[1] Rowan, W , "Relation of Light to Migration and Developmental Changes", NATURE, 115, 494 , 1925

The Antihæmorrhagic Vitamin of the Chick

OCCURRENCE AND CHEMICAL NATURE

IN earlier papers[1,2] a new deficiency disease in chicks has been described which is characterised by a tendency to large hæmorrhages. It has been ascribed to the lack of a specific antihæmorrhagic factor which is different from vitamin C. More recent work has demonstrated that the factor in question is a fat-soluble vitamin occurring in hog liver fat, in hemp seed and certain vegetables, such as tomatoes and kale, and—to a less degree—in many cereals Beef muscle, calf brain and beef lungs desiccated at low temperature are ineffective when they form 20 per cent of the diet, but 20 per cent of dried hog liver will prevent the disease

The antihæmorrhagic vitamin cannot be identical with A and D, since very large doses of these vitamins in the form of concentrates or fish liver oils are ineffective Commercial (α, β) carotene or 4–10 per cent of fresh wheat germ oil do not prevent the disease, but large amounts of wheat-germ oil (24 per cent) afford some protection 3·4 per cent of hog liver fat will completely suppress the symptoms

The vitamin occurs in the easily soluble non-sterol fraction of the non saponifiable matter In hog liver fat it is not destroyed to any great extent by 12 hours heating as a layer 1–2 mm. deep on a boiling water bath, but it appears that there is some loss during the concentration process When the petrol-ether solution of the non saponifiable concentrate is shaken with 90 per cent methyl alcohol, the vitamin remains in the petrol-ether It resembles in these respects vitamin E Further concentration by means of chromatographic adsorption and vacuum distillation using a standardisation method of Schönheyder described below is under investigation

Since hog liver fat is many times as active as wheat-germ oil, it is very unlikely that the anti hæmorrhagic vitamin is identical with vitamin E. I therefore suggest the term *vitamin K* for the antihæmorrhagic factor

It has not been possible to demonstrate the requirement of the antihæmorrhagic vitamin for other animals than chicks, but this point is being investigated further.

H DAM

Biochemical Institute,
University, Copenhagen.
March 19

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[1] Dam, NATURE, 133, 909, 1934
[2] Dam and Schönheyder, *Biochem J*, 28, 1355, 1934

MEASUREMENT AND BIOLOGICAL ACTION

IN a recent paper[1] a deficiency disease in chicks was described, the main symptoms of which were a tendency to large hæmorrhages, certain pathological changes in the gizzard and anæmia The blood of chicks suffering from this disease has a considerably prolonged clotting time, which is undoubtedly connected with these symptoms. McFarlane *et al*[2] have made the same observation on chicks reared on an insufficient diet.

The clotting time has been determined in the following ways. (1) The brachial vein was opened by a slight cut and 2–3 ml blood allowed to drop slowly, during ¼–½ minute, into a small porcelain bowl The time from the vein puncture until complete clotting is called clotting time, which for normal chicks is 1–5 minutes, while it may be several hours for the sick animals. In spite of the roughness of the method, it differentiates between sound and sick animals, and the results are in accordance with those obtained by the following more exact method of measuring the clotting time. (2) The carotid artery is dissected free, a cannula is inserted into the lumen of the vessel and by means of a record syringe 2–3 ml. blood is aspirated and then placed in paraffin coated tubes previously cooled to 0° C The tubes are centrifuged and the supernatant plasma is removed with pipettes into tubes, corked and stored in an ice box This plasma will clot only after addition of a clotting agent (embryonic tissue or lung tissue juice)

Normal and sick plasma show an enormous difference in the clotting time under the same conditions and towards the same clotting agent (technique Albert Fischer[3]) By increasing the concentration of the clotting agent a sick plasma can be made to clot as quickly as the normal The concentration of the clotting agent which clots the normal plasma in 3 min is called 10 That multiple of the concentration 10 which is necessary to clot a sick plasma in 3 min will be a quantitative expression of the morbidity of the animal The plasma of a sick animal will become perfectly normal in a few days by adding a sufficient amount of vitamin K

The quantitative determination of vitamin K is based upon the curative method One unit of vitamin K is the smallest amount which during a certain time can bring a sick animal with a certain degree of morbidity to the normal state with respect to the clotting time

It is difficult to explain theoretically the prolonged clotting time of the blood from a sick animal since there are no morphological changes in the blood, or changes in the fibrinogen or calcium content A change of *p*H is also not the cause The content of the thrombokinase in the tissue of the sick animals is not reduced, nor is there any increase in the content of antiprothrombin in the plasma *The investigations have shown, however, that in normal plasma a component is present which accelerates the clotting of the plasma from sick animals*, even if the concentration of the normal plasma is very small (a few per cent)

It is supposed that lack of vitamin K causes a decrease of the clotting accelerating component in the blood The nature of this component as well as its possible rôle in animal and human pathology is now under investigation

F SCHONHEYDER

Biochemical Institute,
University, Copenhagen
March 19.

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[1] Dam and Schönheyder, *Biochem J*, 28, 1355, 1934
[2] McFarlane *et al*, *Biochem J*, 25, 358 1931
[3] Albert Fischer, *Pflügers Archiv*, 225, 737, 1930

Loss of Velocity of Neutrons in Heavy Water

WE have made some experiments on the Fermi effect produced in silver, when the neutrons are allowed to pass through a layer of heavy water We used double-walled cylindrical glass vessels which could be filled with ordinary water or heavy water of 98 per cent purity The neutron source, a tube containing radon mixed with beryllium powder, was placed in the narrow inner tube of this double walled vessel

The vessels were of two different sizes the smaller ones contained 8 8 gm D_2O or 8 gm H_2O, the difference of radii of the inner and outer cylindrical surfaces of the liquid being 9 5 mm, the larger vessels contained 26 gm. D_2O or 23 4 gm. H_2O, the difference of radii being 15 5 mm During exposure, a silver receiver was pressed against the outer walls of the vessel surrounding the source, and the activity measured afterwards under standard conditions with a Geiger counter With each type of vessel we counted the impulses due to induced activity (*a*) when the vessel was empty, (*b*) when it contained heavy water, (*c*) when it contained ordinary water The results are shown in the accompanying table, the figures are the total number of counts obtained in thirty experiments for each entry. The ratio of the figures in Column *a* is equal very approximately to the ratio of solid angles subtended in both cases

Absorbing layer	Empty vessel (*a*)	Vessel with heavy water (*b*)	Vessel with ordinary water (*c*)	*b*/*a*	*c*/*a*
9·5 mm	1556	1898	4043	1·22	2·6
15·5 mm	654	1335	4173	2·04	6·4

We see that the efficiency of neutrons in producing the Fermi effect is considerably increased when the neutrons pass through a comparatively thin layer of heavy water This increase must be ascribed to the slowing down of neutrons resulting from their collisions with diplons The effect is smaller in heavy than in ordinary water because in a head on collision with a diplon the neutron loses only two thirds of its velocity Calling d_1 and h_1 the coefficients by which the efficiency of neutrons is multiplied when they pass through 9·5 mm heavy and ordinary water, d_2 and h_2 the corresponding coefficients for the thickness 15·5 mm, we see that d_2/d_1^2 is greater than h_2/h_1^2 This means that a small increase of the thickness of the scatterer corresponds to a *relatively* greater increase of the coefficient *d* (heavy water) than of the coefficient *h* (ordinary water) This difference is probably due to the fact that in the case of collisions with diplons the effective scattering takes place mostly in the backward direction, while in the case of collisions with protons the scattering is always in the forward direction For this reason, in our arrangement multiple scattering must play a more prominent rôle in heavy than in ordinary water

Experiments on the slowing down of neutrons in compounds of hydrogen were made by Westcott and Bjerge[1], who were led to the conclusion that the mean free path of the neutron in the scatterer decreases with their velocity and that their efficiency in silver is inversely proportional to the energy Assuming that the cross sections of diplons and protons for collisions with neutrons are only slightly different, we find that the ideas put forward by Westcott and Bjerge account also in a satisfactory way for our experiments

We have satisfied ourselves that the effect of heavy water described in this letter is not due to neutrons produced in heavy water by the gamma rays of radium C′[2], because with the small quantity of radon (40 millicuries) at our disposal, no radioactivity could be detected in silver exposed to a tube containing radon but no beryllium and surrounded by 26 gm heavy water

H **HERSZFINKIEL.**
J **ROTBLAT**
M **ZYW**

Mirosław Kernbaum Radiological Laboratory,
Warsaw
March 18.

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[1] C H Westcott and T Bjerge, *Proc Camb Phil Soc*, **31**, 145, 1935

[2] T E. Banks, T A Chalmers and F L Hopwood, NATURE, **135**, 99, Jan. 19, 1935

Atmospheric Condensation Nuclei

WE have measured the diffusion coefficients and the rates of fall under gravity in air of atmospheric condensation nuclei The values obtained for the diffusion coefficients are fairly consistent, the average being about $D = 18 \times 10^{-6}$ cm.^{2}/sec The well-known relation between mobility in an electric field and diffusion coefficient gives mobility $= D \times eN/P$ If e is the electronic charge, eN/P is very nearly 40, and the corresponding mobility is $7\cdot2 \times 10^{-4}$ cm/sec/volt/cm, which is a probable average value for the mobility of the large atmospheric ion

The values obtained for the rate of fall show more scatter, but observations made with two apparatus of quite different construction agree in giving a mean value of about $0\cdot7 \times 10^{-4}$ cm/sec Comparing the rate of fall under gravity with the mobility, we have $mg \times 300/e = 0\cdot7/7\cdot2$ This gives for the mass of the condensation nucleus $m = 1\cdot6 \times 10^{-16}$ gram If it be assumed that the nucleus is composed for the greater part of water, the radius corresponding to this mass is $3\cdot4 \times 10^{-6}$ cm This is in good agreement with values derived by the application of the Stokes Cunningham law to mobility data

Details of the experimental methods employed will be given in a later publication From results already obtained, it appears that by these methods it will be readily possible to investigate the sizes of condensation nuclei under different conditions The question of variation in the size of the nuclei has been the subject of much discussion, but no method of making measurements appears to have been hitherto available

J J NOLAN
V H GUERRINI

University College,
Dublin
Feb 16

Titration Curve of Vitamin B_1

THE titration curve technique furnishes a convenient method of studying the constitution of ionisable organic compounds the possibilities of which seem to be insufficiently appreciated by many organic chemists From one relatively simple operation, information can be obtained as to the combining weight, the number of acid and basic groups in the molecule, and their several dissociation constants With the aid of the 'formaldehyde curve' method, it is possible to identify which of the various *p*K values in a given complex ampholyte, acid, base or salt relate to amino, carboxyl or hydroxyl, or sulphydryl groups[1] These measurements can be done on a very small amount of material, for example, no more than a milligram or so when dealing with a substance of the molecular dimensions of vitamin C[2] or B_1

Our first observations on vitamin B_1 were made with a crystalline specimen of the dihydrochloride kindly provided by Prof B. C P Jansen in 1931, and more recently we have examined also specimens of a higher degree of purity obtained in 1934 through the courtesy of Prof Jansen and of Prof R A Peters Essentially similar results were obtained on all specimens, whether derived from yeast or from rice polishings. This supports the view that the crystals represent the vitamin itself in a substantially pure state.

The vitamin dihydrochloride at dilutions around $M/20$ in water has a *p*H value of approximately 3.

On titration with alkali, the curve of a group with *p*K value of 4·9 is the first to appear The combining weight of the vitamin dihydrochloride, determined from the amount of alkali taken in the neutralisation curve of this group, is 330 ± 3 per cent This is in good agreement with 337 for $C_{12}H_{16}ON_4S\ 2HCl$[3], but does not agree with 355 for $C_{12}H_{16}ON_4S\ 2HCl,H_2O$ or $C_{12}H_{18}O_2N_4S\ 2HCl$[4], or 357 for $C_{12}H_{20}O_2N_4S\ 2HCl$[5]

On continuation of the titration with alkali, a further curve is reached with *p*K value of about 9 This curve, however, takes approximately twice the alkali titre of the first Its most striking peculiarity is that equilibrium is only slowly attained After each separate addition of alkali the *p*H undergoes a sharp rise, but then gradually sinks again to a more acid value, equilibrium not being reached until 10 15 minutes A corresponding slow change in equilibrium to a more alkaline reaction is encountered during subsequent back titration with hydrochloric acid These observations point to the presence in the molecule of a distinctive 'pseudo acid' arrangement which is transformed to a labile acid group under the influence of alkali Such pseudo acids are already known to exist in certain synthetic compounds in the pyrimidine and allied series[6]

On back titration with hydrochloric acid it is found that the titrable *amount* of the *p*K9 group has diminished as a result of the action of the alkali Even in a titration carried out at room temperature, a loss of 10 per cent or more may occur, depending on the length of time the solution is permitted to remain at the alkaline reaction This finding suggests that the variations which have been noted in the biological activity of different specimens of vitamin B_1 obtained by different workers may be due (as previously hinted[7]) to a variable degree of inactivation brought about through contact with alkali

In presence of a solution of 5 per cent formaldehyde the *p*K 4 9 curve undergoes a slight shift to a more acid reaction The magnitude of the shift is less than that to be expected for a primary amino group The labile group at *p*K9 is not appreciably affected by formaldehyde This finding is in keeping with the earlier belief that vitamin B_1 activity does not involve presence of an NH_2 group[8] (cf Williams's formula[9])

We are able to add that conclusions somewhat similar to the above have been reached by Ogston and Moggridge[10], who have kindly informed us of their results prior to their publication, and to whom we communicated our earlier findings

Our detailed results will be published later, and observations are proceeding on the behaviour of certain scission products of the vitamin and of a number of synthetic analogues

T W BIRCH
LESLIE J HARRIS

Nutritional Laboratory,
Cambridge
April 15.

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[1] Harris, Birch and Harris, *Biochem. J*, **24**, 1080, 1930
[2] Birch and Harris, *Biochem J*, **27**, 595 1933
[3] See Windaus *et al.*, *Nachrich Göttingen*, 342, 1932 Williams, *J Biol Chem*, **57**, 517, 1935 Kinnersley, O'Brien and Peters, *Biochem J*, **29**, 701, 1935
[4] Windaus *et al*, *Nachrich Göttingen*, 342, 1932 Jansen, *Rec trav chim*, **52**, 366, 1933
[5] Van Veen, *Z. Physiol Chem*, **208**, 125, 1932
[6] Quoted by Jansen (private communication) See also Hilbert, *J. Amer. Chem Soc*, **54**, 2076, 1932 Bergmann and Johnson, *Ber*, **66**, 1492, 1933.
[7] Harris, "Ann. Review Biochem.", **2**, 257, 1933
[8] McCollum and Simmonds, *J Biol Chem* **33**, 55, 1918 Peters, *Biochem J*, **18**, 858; 1924
[9] Williams, *J Amer Chem. Soc*, **57**, 229, 1935
[10] Ogston and Moggridge, *Biochem J*, **29** (in press)

Critical Phenomena in the Oxidation and Self-Inflammation of Hydrocarbons

IN 1933 Townend and Mandlekar[1,2,3] discovered a new phenomenon in the self inflammation of mixtures of air and hydrocarbons They showed that on reaching a certain pressure there was a sharp reduction (100 200 C) in the inflammation temperature Similar effects occur in oxygen mixtures[4,5,6]

Townend and Mandlekar considered that the data were insufficient for drawing a final conclusion as to the character of the above mentioned phenomenon, and advanced a tentative hypothesis in which ignition in the higher temperature range was considered to pertain mainly to the thermal decomposition products of intermediate compounds (probably aldehydes), ignition in the lower temperature range would occur when temperature and pressure conditions favoured the survival and further oxidation of those bodies

An alternative explanation has occurred to us in which, in addition to the direct oxidation $A \rightarrow B$ (1) with velocity w_1 there is a reaction which proceeds catalytically with a velocity w_2 according to the equation $A + X \rightarrow B$ (2) where X is the catalyst The velocity w_1 of the first reaction depends upon the temperature

$$w_1 = ae^{-E/RT}$$

X is an intermediate product of the oxidation and is formed in a reaction differing from the first in that .

$$A \xrightarrow{k_1} X \xrightarrow{k_2} B \qquad (3)$$

The maximum concentration of X depends on the ratio k_1/k_2 and it is natural to suppose that this ratio, and with it $[X]_{\text{max}}$, decreases, with increase of temperature As a rough approximation we may assume that

$$w_2 = k\ [X]_{\text{max}}\ e^{-E_1/RT}$$

It is clear that the reaction velocity w_2 will be very small at both low and high temperatures on account of the smallness of $e^{-E_1/RT}$ and $[X]_{\text{max}}$ respectively in the two cases However, over a temperature range between these two limits, w_2 may be relatively large

If the above hypothesis is correct, the velocity of oxidation of the hydrocarbon, $w = w_1 + w_2$, should increase rapidly with temperature over a very wide range of pressure, and should then pass through a maximum into a region where there is a negative temperature coefficient On still further increase of temperature, the velocity w becomes more and more dependent upon w_1 alone, and should again increase according to Arrhenius's equation

In order to test the above hypothesis, the velocity of oxidation of pentane in mixtures containing $C_5H_{12}+8O_2$ was studied in quartz vessels at various pressures below the ignition limit over a temperature range 300°-500° C

The velocity is represented by $1/t_{50\%}$, where $t_{50\%}$ is the time in minutes during which the pressure rise reaches half its maximum value At low temperatures a fairly large period of induction is observed, after which there is a rapid reaction accompanied by chemiluminescence Up to 337°-345° C, as is evident from the experimental curves given in Fig 1, the reaction velocity increases rapidly with temperature in all cases up to a sharply defined maximum In the temperature interval from 350° to 500° C, the velocity increases very slowly and then, above 500° C, rapidly again, so that for example at $P = 20$ cm and $T = 562°$ C, explosion takes place after a period of induction of 7 seconds The shape of the curves is similar at quite different pressures, and it is natural to draw the conclusion that with increase of pressure we should observe two regions of thermal ignition -at low (c 300° C) and at high (above 500° C) temperatures These have in fact been observed for a series of hydrocarbons by Prettre, Dumanois and Laffitte[6] and by Townend and Mandlekar and others

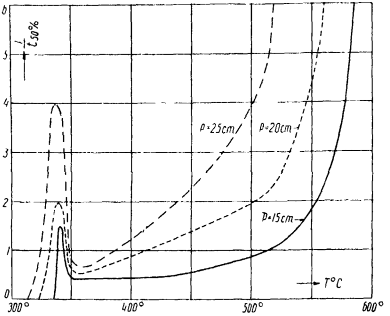

FIG 1

M Neumann
B Aivazov

Institute of Chemical Physics,
Leningrad
Jan 7

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[1] D T A Townend and M R Mandlekar, *Proc Roy Soc*, A, **141**, 484, 1933

[2] D T. A Townend and M R Mandlekar, *Proc Roy Soc*, A, **142**, 168, 1933

[3] D. T A Townend, L L Cohen and M R Mandlekar, *Proc Roy Soc*, A, **148**, 113, 1934

[4] M Neumann and V Estrovitch, Nature, **133**, 105, 1934

[5] H F. Coward, *J Chem Soc*, 1382, 1934

[6] Prettre, Dumanois and Laffitte, *C R*, **191**, 329, 1930

Fundamental Dimensions of Electric and Magnetic Constants μ_0 and K_0

The letter from Prof. Wilberforce in Nature of February 16, criticising my letter in the issue of January 19 on the above subject, shows me clearly that the system introduced into the teaching of dynamics and physics by Prof. Wm. Stroud more than fifty years ago, of allowing all the symbols in equations to contain their own units, is not so well known as I assumed or as it ought to be. This is clearly proved in the introductory paragraph; referring to the dimensions of μ_0 and K_0 Prof. Wilberforce writes: ". . . these dimensions, and not merely the numerical values of the quantities, are both completely arbitrary, depending upon the units of measurement which may be selected".

The Stroud system is fully described in a paper which I read to the Educational Section of the British Association at the Liverpool meeting in 1923, published in *Engineering* of September 28 of that year An example will illustrate its main features The dynamical equation $f = ma$ is a definitional equation defining force, and according to Stroud each symbol contains its own units and dimensions, the equation is true in all units if only the units are written down with the numerical values when these are known For example, a train of mass 100 tons acquires a speed of 60 miles per hour in 5 minutes, what is the average force? $f = 100$ tons × 60 miles/hour/5 min If the force is wanted in tons weight, one ton wt = 1 ton × 32 ft/sec^2 Whence, dividing one by the other and cancelling dimensions, we get $f = 11/12$ ton wt.

The Stroud system has been applied by him and others to all branches of physics and enables one to treat the science in symbols without reference to units, as I have done in my letter In electrical science, for example, $f = ee'/K_0r^2$ is a definitional equation defining electric charge e, and K_0 is a dimensional constant, which is assumed to depend solely upon the medium, it covers therefore our ignorance of the mechanism by which the force is transmitted The charges e and e' can be in ampere-hours, coulombs, c g s E S or E M units, electronic charges or any other units, provided these are written down with their numerical values The same applies to all other equations, hence it provides a means of discussing problems in the science such as, "the fundamental dimensions of μ_0 and K_0", irrespective of systems of units It is as easy to work in electrons and 'magnetons' as in c.g s or any other units Hence the natural system of units which Prof Wilberforce presents does not influence any of my conclusions.

I notice that Prof Wilberforce heads his letter "Dimensions of Electric and Magnetic *Units*", whereas mine was headed "Fundamental Dimensions of μ_0 and K_0 in Electrical Science". I hope that this is the cause of the difference of opinion between us and that now it is clearly stated, he will agree with my deductions

James B. Henderson.

38, Blackheath Park,
London, S E 3.
Feb. 26.

Do Whales Descend to Great Depths?

Dr. F. D. Ommanney, in his letter in Nature of March 16 (p 429), is of opinion that whales cannot descend with impunity below very moderate depths. In his "Discovery" Report on "The Vascular Networks of the Fin-Whale" he limits their normal dives to about 130 ft. and now, in his letter, to 35 fathoms or 210 ft

Old-time whalers, like Scoresby, experienced in the capture of whales by means of rowing boats and hand harpoons or simple gun harpoons, were of the opinion that Greenland whales and certain other whales, when harpooned and trying to escape, do descend to much greater depths and this, except for a temporary exhaustion, without being any the worse

As may be gathered from what Scoresby says, the whalers were of this opinion for a number of very good reasons

(1) The amount of whale line which had to be coiled into the whale boats, in different localities, depended on the depth of the water

(2) In deep water, when a whale 'sounded', or tried to reach the bottom the amount of whale-line it 'took' or drew out was limited and was obviously in proportion to its size and diving powers

(3) When the whale was 'sounding' and drawing out the line, the 'fast boat' behaved as if it was going right down it remained in about the same place

(4) After an interval, the whale reappeared near where it went down, and was easily harpooned a second time by one of the other boats Even a whale that had exhausted all the line in the 'fast boat and was 'loose' or free to escape, came up near where it went down

(5) In deep water, unless I am mistaken, a whale cannot be captured by means of floats or drogues'

A whale was certainly in an exhausted condition when it first came up after a long and deep dive, but if given time and not quickly attacked a second time, it soon recovered and broke loose, to be caught perhaps at some later date with the old harpoon still buried in its blubber At the Greenland Sea and Davis Strait fisheries, many whales were lost through negligence on the part of the nearest assisting boat quickly to 'strike' a whale a second time

In reply to the practical part of Dr Ommanney's letter, I would say that a long submergence is not necessary to permit a whale even when embarrassed by the harpoon and the whale-line to descend to and return from a depth of a mile In the case of whales that did not try to escape by 'sounding', the line taken out was not limited or definite in amount Among ice it was always much more In 1895 in the Greenland Sea, the *Polar Star* of Dundee lost a whale with 3,000 fathoms of line—all attached to a 'first harpoon'

R W GRAY

8 Hartley Road,
Exmouth
March 24

THERE is, I think, no reason why whales should suffer from the troubles which affect divers and caisson workers[1]. There is not enough air in the whale's lungs to produce bubbles of nitrogen in the blood, even if this were mostly absorbed on going down to deep water, and the whale then came to the surface To produce bubbles on decompression, the whale would have to come up, fill its lungs and then go down until the nitrogen in the lungs was absorbed and repeat this operation, so charging itself with dissolved nitrogen. It is most unlikely to do any such thing.

It has been suggested that the lungs fill with water in the depths, and are emptied of water when the whale spouts. But I have come across observations which showed that the spouting took place in a very few seconds, and therefore emptied only the entry of the breathing passages It is most unlikely that the whale would have to spend time on the surface emptying its lungs of water How far the air in the lungs can be compressed depends on the anatomical arrangements and it is this which must control the depth to which the whale goes

LEONARD HILL

Nicholls Wood,
Chalfont St Peter,
Bucks

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[1] NATURE, 135, 429, March 16 1934

Diet of Seals

IN a letter in NATURE of March 23 (p 473), Mr R W Gray says that there seems to be very little scientific evidence beyond that given by Mr G A Steven on this subject, and he objects to the validity of a generalisation on a basis of a study of only three specimens

In the past five years, I have examined four seals caught in the River Tay and have found the stomachs and intestines to contain the remains of fish These included immense numbers of flatfish, sprats and some salmon smolts In addition, there were great numbers of small crustacea, but most of them were forms well known as gill parasites of fish

Incidentally, tolerance and preservation of seals on the southern coasts of England may have had not a little to do with the disappearance of salmon from rivers in that area

FRANK GREENSHIELDS

Natural History Department,
University College,
Dundee
March 25

Nova Herculis, 1934

THE light curve of this nova continues to be abnormal after oscillating between 2^m and 5^m during the months January to March, the star has faded rapidly during the first half of April to 10^m on April 14 At the same time, the spectrum has altered, the chief new lines being due to [Fe II], represented by emission maxima displaced to the violet The two maxima previously present in H, [O I] and Fe II can now be seen only in the hydrogen bands These have faded along with the continuous spectrum, and on April 15 much the strongest line in the spectrum was [O I] 6300, the spectrum now consists predominantly of the forbidden lines of [Fe II], [N II] and [O I], resembling in many respects that of η Carinæ

F J M STRATTON
E G WILLIAMS

Solar Physics Observatory,
Cambridge University
April 16

Word-Association Tests of Trance Personalities

THIS method of investigation[1] has recently been continued and extended with the following results

1 In a special experiment by Besterman and Gatty, the latter, acting as subject, was tested alternately in two 'poses' or 'orientations of mind' based on different aspects of his own life No attempt was made to give different reactions to particular pre selected words; but, in spite of this, *significant differences* were found between the two states, as regards both reaction time and reproduction test

It follows that such differences are not, as I had at first supposed, evidence *per se* of the autonomy of the personalities compared

2 Using the term 'controls' to denote trance personalities specifically associated with the medium, as opposed to 'communicators' which are specifically associated with the individual 'sitter', I find that there is a significant tendency for controls to show, in respect of rection time, the equivalent of a negative correlation- which I am terming 'countersimilarity' —when compared with other personalities Thus, of 10 comparisons involving 'Feda' (Mrs Leonard's control), 8 give a negative and 2 a positive result, while of 12 comparisons not involving Feda only 1 is negative and 11 are positive The chance of this disparity being fortuitous is less than 1 in 2,000

The same tendency is observable with 'Uvani' (Mrs Garrett's control) though to a lesser extent corresponding to the smaller quantity and inferior quality of the material available

This curious phenomenon seems explicable only on the assumption that 'Feda' and 'Uvani' are true secondary personalities formed round nuclei of repressed material The fact of repression seems calculated to produce in respect of certain words a longer reaction time for the normal than for the secondary personality, and probably vice versa, thus affording a basis for the inverse relationship observed

Since the effect is not found in the case of communicators, it would appear that these, if they are to be regarded as modifications of the medium, are of a different type from controls and formed in a different manner On the assumption that their claim to autonomy is ill-founded, they would seem to be more in the nature of histrionic poses than secondary personalities in the pathological sense

3 Normal persons, controls, the Gatty poses, and the one 'automatic' state hitherto examined—a total of 10 personalities—agree in showing, subject to very minor qualifications, a significant association of prolongation in reaction time with disturbance in reproduction This indicates that these diverse kinds of state—whether normal, secondary, 'posed', or of a presumably dissociated character—are at least 'undivided' in the sense that a single source is responsible for both times and reproductions

This is not true in the case of two out of the three communicators studied In each of these, one set of reactions is indistinguishable from those of the normal medium -the other, equally well defined, is significantly different There is accordingly a strong suggestion to the effect that two factors are here at work, of which one, if not extraneous altogether, is derived from some state or level of the medium's mind other than the normal, despite the fact that it is contemporaneously operative with it

The third communicator shows the association between reaction time and reproduction which indicates an undivided personality, but in this case there is no significant similarity to the normal medium in respect of either component, though only one (reproduction) is significantly different Probably the minimum straining of the evidence is required by supposing that this personality has achieved in both respects a separateness from the normal medium—of whatever kind this may be—which the other two have achieved in one respect only.

WHATELY CARINGTON.

Rotterdam.
Feb. 23.

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[1] NATURE, 134, 187; 1934 *Proc. S.P.R.*, Part 136

Alleged Anæsthesia Produced Electrically

MR F. DE LA C CHARD, in defending the electric 'stunning' of animals[1], states that it is "only a matter of time before . research confirms the opinions expressed by eminent physiologists in favour of electric anæsthesia for animals" By thus prejudging the issue, Mr Chard illustrates the very attitude against which my letter was a protest

Mr Chard adds some sweeping generalisations One is that "Animals are very much more susceptible to electric shock than humans" In the systematic researches of such workers as Kouyvenhoven I can find no evidence to justify this statement. He also claims that unhealthy subjects are less susceptible to electric effects than are healthy ones, but Jellinek, a leading authority on electrical accidents, holds the contrary view[2] He claims also that "In electrical accidents, severe burning has been felt only as a 'stinging sensation' " But in other accidents severe pain has been felt The results of accidents vary so widely, according to the many variable factors concerned in them, that no such generalisation is worth consideration

Mr Chard's reasoning leads him to one conclusion that can be definitely tested by experience and proved to be wrong He concludes on theoretical grounds that the "A C is twice as effective as the intermittent D C used by Regensburger" But Regensburger produced exactly the same effects that are got in the slaughterhouse with A C , that is to say, *when his current was too weak the pigs recovered too quickly and when it was too strong the reactions were too great for commercial requirements* The point that Mr Chard has overlooked is *that the rate of change of the current is an important factor as well as the amplitude*

The real point at issue is that electric 'anæsthesia' has been pronounced genuine on the strength of two tests (i) absence of response to pain stimuli, and (ii) absence of pupil reflex Hertz's experiments have proved that these tests are not valid in the case of electric immobilisation, and we are therefore without any means of knowing whether, or at what stage, insensibility supervenes My letter was a protest against attempts to short circuit the need for knowledge

C. W HUME

14 The Hawthorns,
London, N 3
March 17

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[1] NATURE, 135, 343, March 2, 1935

[2] Quoted in Taylor's "Principles and Practice of Medical Jurisprudence", vol 1, p 528, 1934

Newton and Spinoza

WITH regard to the new biography of Isaac Newton by Prof More and to the review in NATURE of January 5 (p 3), the following considerations may be of interest Brought up in a family devoted to the Royalist cause, Newton became a staunch Whig As a fellow of Trinity College he is said to have been influenced by the Platonists, but in spite of this, Newton became a man of science who is far from Henry More's mystical Paracelsic ideas. We must ask how this astonishing development took place, even if we suppose that Newton's genius was essentially responsible for it. I believe that no biographer has yet pointed out the possibility of Spinoza's views having influenced Newton, for this great Dutch-Jewish philosopher was the only one among the philosophers of the seventeenth century who may be ranked with Newton. Oldenburg, secretary to the Royal Society, visited Spinoza at his residence at Rhynsburg in 1661 and was in correspondence with him from 1661 until 1665 and afterwards, 1675–76, concerning scientific, philosophical and theological problems. It is known that Boyle was interested in Spinoza's view, and it is most probable that Newton too had some knowledge of Spinoza and his works. The "Theological Political Treatise" (1670) greatly influenced English metaphysicians, for example, Locke. It might have influenced Newton's political and theological views as well.

Of still greater importance is the question of the sources of Newton's scientific work. If his thoughts about space and time were influenced by More, there is already a contact with Spinoza, because Spinoza may also have been influenced by More (see Prof. L. Roth's 'Spinoza", p. 70, Ernest Benn, Ltd., 1929). But there is a great difference between the mysticism of the Platonists and the definiteness of Spinoza and Newton. In their conception God is not hidden in Nature, for they sought to find Him there; the universe is for them rational. We find in Newton's thoughts the same monistic and deterministic characteristic traits as in Spinoza's. For both, philosophy and science are impersonal statements of impersonal truth. The geometrical demonstration of Spinoza's "Ethics" (1677) is an expression of this impersonality, and I suspect that the deductive form of the "Principia" (1687) is derived rather from the "Ethics" than from Euclid. In the 'Principia", and also in the "Queries" of the 'Opticks", there are passages which seem to express pantheistic ideas. Certainly there are other passages which may express an opposite point of view, but it is well known how great the prejudices of the time were and that Spinozism was regarded like atheism, and was therefore persecuted.

Prof. More has studied all the documents regarding to Newton, and as he does not say anything about Newton's connexion with Spinoza, there seems to exist no written proof. We may suppose that Newton himself would have destroyed all documents or that his first editors tried to efface all evidence of a damaging relationship.

OTTO BLÜH

German University,
Prague.
Feb. 24.

Points from Foregoing Letters

PROF. W. ROWAN and Mr. J. Gregson report that the disease-carrying tick, *Dermacentor andersoni*, which hitherto refused to feed upon rabbits during winter, was induced to do so when the host was 'modified' by previous gradually increased illumination.

Chicks fed upon a special diet developed a deficiency disease leading to changes in the gizzard, and to anæmia and hæmorrhage. The disease was cured by foodstuffs like hog liver fat, hemp seed and certain vegetables. Mr. H. Dam considers that these contain an essential new vitamin K. This cannot be identical with the already known vitamins A and B, since fish-oils, which contain both these vitamins, do not cure the disease. Mr. F. Schönheyder describes the tests used in determining the change in the clotting time of the blood of plasma of diseased chicks. These tests serve to estimate the quantity of vitamin K present.

The ability of neutrons to render silver radioactive has been shown by Messrs. Herszfinkiel, Rotblat and Żyw to be increased by passing them through heavy water, though to a less extent than by passage through ordinary water (Fermi effect). A small increase in the thickness of the heavy water layer leads proportionately to a greater activity than in the case of ordinary water, and this is attributed to the fact that neutron-scattering takes place backwards in heavy water and forward in ordinary water.

Although the anti-beriberi vitamin B_1 was the first vitamin to be discovered, its chemical composition and structure are still uncertain. Drs. T. W. Birch and Leslie J. Harris, from the change in the intensity of acidity-alkalinity (*p*H) upon addition of alkali to a solution of the purified vitamin, calculate its molecular weight to be about 330. This agrees fairly well with the formula $C_{12}H_{18}O_2N_4S.2HCl$. They also find evidence for the presence of an atomic arrangement that changes under the influence of alkali, and may be responsible for the variations in biological activity observed by different investigators.

The velocity of oxidation and self-inflammation of hydrocarbons is of great importance in connexion with the combustion engine. Prof. M. Neumann and Mr. B. Aivazov have determined the velocity of oxidation of mixtures of pentane and oxygen in order to test the hypothesis that the sudden increase in this constant, which occurs at a certain temperature and pressure, is due to an intermediary catalytical reaction. They find, in accordance with expectations, a maximum velocity at 340° C.

Sir James Henderson, replying to Prof. Wilberforce's criticism of his treatment of the dimensions of μ_0 and K_0 in electromagnetic theory, contends that these dimensions are not arbitrary, and that this follows from Stroud's system wherein every symbol occurring in a physical equation contains its own units.

In answer to Dr. Ommanney's objection, Mr. R. W. Gray recapitulates Scoresby's observations which have led him to infer that whales can descend to great depths, 700–800 fathoms (not 2,500 fathoms as stated in NATURE of March 16, p. 429). Sir Leonard Hill expresses the opinion that whales need not suffer from caisson disease after deep diving as there is not enough air in their lungs to produce bubbles of nitrogen in the blood when the animals come back to the surface.

Mr. Whately Carington, having carried out, with normal and 'psychic' persons, further word-association tests (time taken to respond to a list of words and type of response) finds that the 'significant differences' which he had previously found between medium and control, are also shown by other people in different 'orientations of mind'. He finds now a negative correlation between the time-reaction to certain words which the medium gives in normal and in the 'trance' state. From this he deduces that 'controls' which speak through the mediums are secondary personalities formed round nuclei of repressed material.

Research Items

Stone Structures in the Western Transvaal. A number of stone structures ascribed to "the ancients" have been investigated by Dr. Ir. E. C. N. van Hoepen and Dr. A. C. Hoffman (*Argeologiese Navorsing van die Nasionale Museum*, Bloemfontein, Dl. 2, St. 1). These structures are situated at Buispoort, 24 miles north-west of Zeerust, and consist of stone walls which have served for huts, enclosures around huts and for cattle. There are also walls which served as storage platforms for grain bins, semi-circular to nearly completely circular stone rings surrounding threshing floors, small structures for storing grinding stones, furnaces for smelting iron ore, heaps of slag, ash heaps and remarkable graves. On the evidence of both Campbell and Moffat, and taking into account the reputation of the Bahurutsi for iron working, it is concluded that these structures are the work of the ancient Bahurutsi, especially as skulls found here are similar to recent Bahurutsi skulls from Braklaagte. These structures corroborate and substantiate for the first time the fact that the Bantu did build with stone. This has an important bearing on the problem of the Zimbabwe culture. The graves found were all covered-in fissures between rocks. Many bones show signs of burning, which may be due to their burial after a Matabili raid in which the houses with their occupants were burned. A number of furnaces, without doubt for the production of iron, have been found. Potsherds and two or three broken pots were found. The material is coarse, and it contains foreign matter which does not improve the clay. It was probably introduced without clear understanding of its operation in firing. Three or four definitely globular pots were found. These are rare among the modern Bahurutsi. Pots with three legs had reached a culminating point, the legs being of enormous size. A pot with a gradually thinning lip may have been introduced by strangers.

The Manatees. Not since Hartlaub's paper of 1886 has an attempt been made to monograph the manatees (genus *Trichecus*), and Robert T. Hatt's contribution on the group in the "Scientific Results of the Congo Expedition" establishes a few hitherto unrecognised characters for the distinction of the crania of the different forms, corrects certain erroneous conclusions come to by Hartlaub, and records for the first time specific features of the post-cranial skeleton (*Bull. Amer. Mus. Nat. Hist.*, **66**, 533; 1934). While admitting only three living species of manatees, one African and two American, the author considers it probable that geographic extremes of these species are racially distinct. But the Congo specimens showed no character that could distinguish them from the better known forms from Senegal. The African species (*T. senegalensis*) is more closely related to the West Indian species (*T. manatus*) than to the South American *T. inunguis*, so that there seems to be a stronger linkage in this case between the distant African and West Indian species than between the neighbouring American species.

Bacterial Decomposition and Synthesis of Cellulose. Mme. Y. Khouvine, who has been responsible for much work on the decomposition of cellulose, has recently reviewed briefly the present position in this field (Actualités scientifiques et industrielles, 164. "Exposés de chimie biologique." (2) "Cellulose et Bactéries." Paris: Hermann et Cie). In it she deals in turn with the chief aerobic, anaerobic and thermophilic bacteria that have been described as cellulose decomposers. As in many other publications, the organism *Spirochaeta cytophaga*, first isolated by Hutchinson and Clayton in 1918, and known now as *Cytophaga Hutchinsoni*, is named as being the most numerous and active cellulose-decomposing organism in the soil, though, in point of fact, it has never been conclusively shown to be active in attacking the cellulose of plant residues. It is a little unfortunate too that fungi are not dealt with as well as bacteria when considering cellulose-decomposition, for there is no doubt that under aerobic conditions the former group is of great importance. The last part of the present useful little work is devoted to the consideration of the synthetic activities of *Acetobacter xylinum*, which when growing on sugar alcohols such as mannitol or sorbitol, produces acid, and on the surface a membrane now shown by Hibbert to be true cellulose. The crystallites are not oriented as in a fibre, but by tension may be partially aligned so that an X-ray diagram is obtainable not very dissimilar from that of cotton. Details of the culture of this organism are given, and its fermentative reactions considered.

Chromosome Homologies in *Drosophila*. *Drosophila melanogaster* has four pairs of chromosomes while *D. pseudo-obscura* has five pairs. In the latter species, five linkage groups of genes have been found, and a further study of this species (Crew and Lamy, *J. Genet.*, **30**, No. 1) indicates that snapt and tilt (wing characters) and sepia (eye colour) are located in the left arm of the *X*-chromosome, which corresponds in part with the right arm of chromosome III in *D. melanogaster*. On the right arm of the *X* are located eosin and cuprous. The rod-shaped chromosome III of *D. pseudo-obscura*, which contains the dominant stubble and the recessive glass (eye), is found to be homologous with a considerable portion of the left arm of chromosome III in *D. melanogaster*. The mutations short and jaunty in the fourth linkage group of *pseudo-obscura* (a small rod-shaped autosome) may be homologous with part of the right arm of chromosome II in *melanogaster*. Thus it appears that there has been a considerable rearrangement of the chromatin material since these species diverged from a common ancestor. The authors also discuss the nature of the action of the genes for eye colour, based on observations of colour changes during ontogeny and on the colour effects produced on eye and testis sheath by various gene combinations. They conclude that these genes are not directly concerned in pigment production, but act on the mechanism which is responsible for production and deposition of pigment, the colour of the pigment being determined by the chemical conditions at the stage of development when the pigment is formed.

Malayan Orchids. A paper on "Some Malayan Orchids" appears in the *Gardens' Bulletin* of the Straits Settlements (8, Part 2, Jan. 26, 1935). It is by Mr. C. E. Carr, and describes the orchids collected by the Oxford University Expedition to Sarawak in 1932. The plants were obtained from the neighbourhood of Mount Dulit, at altitudes varying from near sea level to 1,400 metres. 132 species were collected, and 32 are now described for the first time. Descriptions of the species are very complete, and lengthy diagnoses of new species appear in Latin and English. A perusal of the descriptions suggests that many kinds will in the future, add even greater beauty to our already beautiful English orchid houses. An attempt is made to describe the perfume of several species, and both the systematic botanist and the gardener will find a great deal of interest in the paper. Members of the genera *Bulbophyllum*, *Coelogyne*, *Dendrobium*, *Dendrochilum* and *Eria* predominate in the list.

Entomogenous Fungi. Mr. T. Petch has recently published further "Notes on Entomogenous Fungi" (*Trans. Brit. Mycol. Soc.*, **19**, Part 3, 161–194, Feb. 1935). Having already described seventy five species of fungi which attack insects, Mr. Petch continues with No. 76, and his present paper finishes with No. 100, but a very useful review of the entomogenous species of the genus *Cladosporium*, and the description of eight new species of fungi relieve its abruptness and make it complete in itself. Eight species of *Cordyceps* are described critically, whilst fungi of this genus which attack orthopterous insects receive special mention. The new species are *Blastotrichum aranearum*, on spiders, *Hirsutella radiata*, *H. formicarum*, on ants, *Verticillium fuliginosum*, *Sporotrichum columnare*, *Metarrhizum brunneum*, *Patellina epimyces* and *Stereocrea coccophila*. Most of the fungi are foreign to Great Britain, and many have been collected from Ceylon.

Baluchistan Earthquakes of 1931. The recently issued part of the Memoirs of the Geological Survey of India (**67**, 1. 82, 1934) contains an interesting study by Mr. W. D. West on the destructive Baluchistan earthquakes of August 25 and 27, 1931. The district is one that is frequently visited by earthquakes, the most important predecessors being those of December 20, 1892, and October 31, 1909. Of the two recent earthquakes, the earlier and less intense, known as the Sharigh earthquake, occurred at about 3.5 a.m., I.S.T. (August 24, 9.35 p.m., G.M.T.). The epicentre was close to Sharigh and its focus was clearly shallow, for, though the intensity was 8 (Rossi-Forel scale) in the epicentral area, it faded away rapidly, so that the total area disturbed was only about 31,000 sq. miles. The second, or Mach, earthquake occurred on August 27 at about 8.57½ p.m., I.S.T. The epicentral tract was a long, narrow, curved band, following closely the strike of the rocks for about 100 miles in a general southerly direction from Mach. Within this band, the shock reached the intensity 10, and caused much destruction to buildings. The disturbed area covered a large part of Baluchistan and Sind and contained about 370,000 sq. miles, or about the same as that of the Californian earthquake of 1906. The epicentres of both earthquakes were closely related to the re-entrant angle in the eastern boundary of the Baluchistan Hills, that of the Sharigh earthquake being on the northern side, and that of the Mach earthquake running parallel to the south-western side, of this angle.

Use of Drilling Mud in Burma Oilfield. The search for new and deeper sources of oil in the fields of India and Burma has during recent years been complicated by heaving or caving shales and high-pressure water issues. Laboratory experiments and field experience have shown that the former difficulty can be surmounted by selection of a drilling fluid from which there settles out, when mixed, a minimum of free water. Also, to discourage penetration of formation water into the hole, the fluid must either be sufficiently heavy in itself to overbalance formation water pressure or failing this, it must be loaded with barytes, iron oxide, etc. High pressure water issues, whether associated with heaving and caving or not, can be combatted only by application of sufficient pressure to counteract formation water pressure; this is done by the use of a loaded drilling fluid and back pressure supplied by the drilling equipment. Mr. A. W. G. Bleek, in his paper "Some Experiences in the use of Drilling Fluids in the Yenangyaung Oil-field, Upper Burma" (*Trans. Min. Geol. Inst. India* **39**, 3, December 1934), after an exposition of these difficulties, proceeds to record personal observations made during the deepening of a well in the southern extremity of the Yenangyaung Field, Burma. All previous attempts at deep drilling in the neighbourhood had failed, and records showed that, in the case of the present well, heaving and caving must be anticipated; also water lying between 4,800 ft. and 4,900 ft. was believed to be high pressure water. Actually no high pressure water issues were encountered and the problem was, therefore, confined to prevention of heaving and caving and exclusion of formation water. Back pressure drilling equipment was not called into operation though it was ready on site, and the successful deepening of this well is attributed to the use of a mud fluid which, while preventing heaving and caving, was possibly also responsible for the absence of high-pressure water issues, which are frequently attributed to poor quality fluid and consequent encouragement of flowing shales.

Ozone in the Atmosphere. A. R. Meetham and G. M. B. Dobson (*Proc. Roy. Soc.*, A, March 15) have investigated the vertical distribution of atmospheric ozone in a high latitude (Tromsø, lat. 69° 40′ N.). The method used involves the measurement of zenith sky light at two wave-lengths for various zenith distances of the sun, and it has already been applied in Switzerland, yielding results which were confirmed by Regener's sounding balloon measurements. The height of the centre of gravity of the ozone is nearly the same at Tromso and at Arosa, but the distribution is rather markedly different. At Tromsø the ozone is more concentrated in a region about 21 km. high, while in Switzerland it is more uniformly distributed through the lower 30 km.

A New Form of Cloud Chamber. C. T. R. Wilson and J. G. Wilson (*Proc. Roy. Soc.*, A, Feb. 15) describe a new type of cloud chamber which possesses very interesting features and may be further developed. In this chamber the flow of air when the expansion takes place is radial, the air leaving the chamber by slits left between flat rings of slate which are piled to form the walls of the chamber. The corresponding distortion of the tracks is a uniform two dimensional magnification. Both back and front of the vertical chamber are of glass, and the illumination is supplied through the back, the light being stopped out of the camera as in microscope dark-ground illumination. Since the tracks scatter much light through small angles, the illuminating arrangement is very efficient. Another important innovation consists in allowing the chamber and its auxiliary gear to fall freely under gravity, it being released as the expansion takes place. It is claimed that the chamber may thus be removed from a confined space, for example, the pole-gap of a magnet, before the photograph is taken. Since gravitational forces do not affect the contents of the chamber, convection currents are prevented and the tracks retain their form for a long time. This may prove an important advantage for some types of work.

Isotopic Water in the Sea. The densities of samples of water from different oceans have been found by H. E. Wirth, T. G. Thompson and C. L. Utterback (*J. Amer. Chem. Soc.*, **57**, 400; 1935) to be very uniform for the Mediterranean, Red Sea and Indian Ocean, with one exception of water obtained at 4,000 metres in the Indian Ocean, which gave the highest values ever found. No surface specimen from this locality was available. Low values were found for samples from the Antarctic, North Pacific and Bering Sea. One result of the investigations was that regions of high dissolved oxygen content are those of low density, and conversely. Waters from the Baltic showed low density differences from ordinary distilled water, which are attributed to dilution by land drainage, and a region of the San Juan Archipelago noted for its abundant fauna and flora yielded waters of low density differences. The paper describes an apparatus for measuring small differences of density of the order of 10^{-6}, depending on the communicating tube method; the liquid heights were altered by means of metal plungers and an oscillation circuit was used.

Element 93. The experiments on the bombardment of uranium with neutrons led Fermi to conclude that elements with an atomic number above 92 are formed (NATURE, **133**, 898; 1934). It was assumed that the product, with a period of 13 minutes, which is precipitated from a highly oxidising and acid solution along with manganese, is the highest homologue of the latter, or element 93. A. V. Grosse and M. S. Agruss, however, had expected other properties for this element, and they now describe (*J. Amer. Chem. Soc.*, **57**, 438; 1935. See also NATURE, **134**, 773; 1934) some experiments in which protactinium, the longest lived isotope of element 91, was used as an indicator in experiments similar to Fermi's. Manganese dioxide and rhenium sulphide were precipitated from uranyl nitrate and protactinium solutions. The behaviour of element 91 and the reported behaviour of element 93 were found to be identical within the limits of experimental error. The authors, however, report that Fermi has tested whether the artificial radioelement is precipitated with zirconium phosphate, the coprecipitation being a very clear and definite reaction for element 91, and has found that the active products are not precipitated, which speaks against identity with element 91.

Properties of the Telephone Transmitter. The design of early types of telephone transmitter was almost entirely empirical. In the commercial form, the electrical resistance of a small column of specially prepared carbon granules is made to vary by the sound waves which it is desired to transmit. In appearance the carbon granules are like granite chips, and the column consists of a series of sharp corners and edges in contact with more or less plane surfaces. In the Engineering Supplement to the *Siemens Magazine* of March, it is stated that the Company, seeing that the limit of progress on purely empirical lines was practically reached, decided to attack the problem experimentally and theoretically, and appointed Mr. G. W. Sutton to analyse the working of the 'Neophone transmitter' and to measure its mechanical and electrical properties if possible. He describes in this supplement a new method of measuring these properties, and attempts to make a complete analysis of the 'Neophone' transmitter, which incorporates some of the latest developments. The influx into the industry all over the world of a younger generation of engineers trained in the modern technique of acoustics and of audio-frequency engineering has enabled research work on a larger and more effective scale to be done. The introduction of new raw materials and of improved factory processes has also helped. The author has collected many experimental data which will be found useful. Considering that the time permitted for the research was somewhat limited, the agreement between the calculated curve and the observed frequency characteristic is very good. The demand for an improved quality of speech in telephone transmission probably arises from the education of the faculty of discrimination of the public by the gramophone and by broadcasting.

Current Measurement at Radio Frequencies. At a meeting of the Meter and Instrument Section of the Institution of Electrical Engineers on April 5, Dr. H. E. M. Barlow read a paper entitled "A Valve Ammeter for the Measurement of small alternating Currents of Radio Frequency". This paper comprised a description of an alternating current milliammeter having four ranges, 5, 10, 20 and 30 milliamperes and suitable for measurements at frequencies from 25 cycles to 5 × 10^6 cycles per second. The instrument makes use of a two electrode thermionic valve, with its direct current supplies arranged to give the saturation current in the anode circuit. Under these conditions, if the temperature of the filament is raised by a small amount, a rapid increase takes place in the saturation current. Thus if an alternating current is superimposed on the direct current through the filament, the increase in the anode current provides a measure of the alternating current. In the first arrangement of the instrument described in the paper, suitable filter circuits are included to restrict the alternating and direct currents to their appropriate paths. A simple resistance-bridge arrangement is connected in the anode circuit, by means of which the steady current through the galvanometer is balanced out. On the application of alternating current the balance of the bridge is upset, and the deflection of the galvanometer indicates the value of the current to be measured. An alternative arrangement of the instrument employs a second valve so connected in the circuit that any drift of the galvanometer zero, due to variation of filament battery voltage, is avoided. Among the advantages claimed for the instrument are that it is sensitive and quick in response, that several ranges can easily be incorporated in one instrument, and that it has a high overload capacity. A typical calibration curve for an instrument having a range of 5 milliamperes is included in the paper, and shows that the accuracy of indication is within 0·5 per cent from 25 cycles per second up to nearly 5 megacycles per second.

Fruit Soil Survey

THE county of Kent, along with its neighbours Surrey and Sussex, became classical ground for the scientific survey of soils after the publication of "A Report on the Agriculture and Soils of Kent, Surrey and Sussex" by Sir Daniel Hall and Sir John Russell. Now, more than thirty years after that auspicious pioneer work, a "Survey of the Fruit-growing Areas on the Lower Greensand in Kent" has been published by the Ministry of Agriculture and Fisheries (Bulletin No 80. Pp 81 H M Stationery Office, 1934 3s net). The Survey reports extensive work by Messrs W A Bane, of East Malling Research Station, and G. H Gethin Jones, of the South Eastern Agricultural College, Wye, and collects the results of a large number of observations.

It is only by the application of intensive methods of soil survey to small areas that they can be made of use to the practical grower. This has been done in the survey under review, and as a result, twenty six types of soil have been recognised. Of these, only about six are regarded as naturally good for the growth of fruit, though others are classified as average or fairly good. Good soils cover extensive areas. Estimation of the suitability of particular soils for the needs of a particular crop is not easy, but the survey under review takes into account such factors as soil water, drainage and the less tangible effects of such features as management.

The solid geology of the district is illustrated by a coloured map inserted in the Bulletin, and by a very useful diagrammatic section, in addition to descriptions in the text. Methods of soil classification are based upon the American method of field examination. Soils which have the same geological origin, similar water relations and profile, and analogous topographical position are placed in the same series. Each series is subdivided into types according to the texture of the surface soil, and each type may have one or more 'phases', according to variation in such features as depth or drainage.

Several valuable conclusions emerge from the report. The area of Kent covered by the Lower Greensand is undoubtedly very suitable for the growth of tree and bush fruit. Water conditions of soils in this area seem to determine their suitability for fruit growing, rather than physical nature of the particles. The question of draining is dealt with in an interesting manner, and it is shown that two soil series known as the Malherbe and Cox Heath are both troubled by excess of water in winter. The Malherbe series can be improved, by draining, for a certain type of fruit growing, whilst it is "doubtful whether the cost of such work would be repaid on the Cox Heath series". Heavier soils derived from the Folkestone sand strata can be used for fruit growing, if careful manuring, particularly with potash, is performed. Lighter soils from the same strata cannot be improved profitably.

Soil survey has been correlated carefully with the use of such special practices as ringing, and studies of varying root systems in different soils and on different rootstocks open up interesting possibilities for future work. The survey of existing fruit plantations reveals the fact that a large proportion contain apple trees which are unsuited to modern needs, are grafted upon rootstocks unsuited to the type of crop desired, and are not spaced to the best advantage.

There can be no better advocate of improved cultivation than the presence of East Malling Research Station in the area under survey. Results from this Station are of the highest practical value, and indicate, among other things, that fruit of dessert quality might be grown more extensively in the area, rather than that of culinary grade as at present. The Survey is already welcomed by the more progressive trade organisations as a valuable contribution to the age-old industry of fruit-growing.

Pygmies of Central Africa

THE difficulty of placing the pygmies of Central Africa in such a position in a scheme of ethnological classification as will be generally accepted as convincing is well known. To a certain extent this is due to the lack of adequate detailed information bearing on their physical characters; but in part it also arises from the fact that such material as has been available did not readily admit of comparative study of variation among the pygmies themselves. This applied especially to the question of the degree to which they were related to, or showed evidence of admixture with, the peoples of greater stature, the negroes, among whom they had their habitat.

It was, therefore, welcome news to anthropologists that Paul Schebesta, who had made a study of the pygmies of the East, and more especially of the Semang of the Malay Peninsula, was undertaking an expedition to the Congo for the purpose of studying and measuring the African pygmies.

P Schebesta's expedition was in the field in 1929–30. It was made possible by the generous assistance of the Charles University, Prague, the Comenius University, Bratislava, and a contribution was received from the Dr Aleš and Mrs. Marie Hrdlička Fund. The material collected has been analysed by Prof Victor Lebzelter, who had dealt similarly with the Semang material collected by P Schebesta, and the combined report has been published by the Czech Academy of Sciences and Arts*, the tables of original measurements being included and an English translation appended.

In the first section of the report, P. Schebesta deals with the demography and morphology of the pygmies, the anthropological analysis by Prof Lebzelter forming the second part. The peoples or groups who came under observation fall into two categories—the pure pygmies of the Ituri Forest region, who are distinguished by special somatic features, and the pygmiforms—a term here preferred by the authors to 'pygmoid', as this latter term is generally used to include peoples who approach the pygmies in their small growth only The pygmiforms, while presenting racial features of the pygmies which are absent in the pygmoids, differ from the standard pygmaean type without being negroes Some of the pygmiforms approach the standard pygmy closely, others differ widely The pygmiforms, or mixed types, are already to be discerned on the periphery of the Ituri region, especially on its northern border The pygmiforms who came under the observation of the expedition were Batwa in Ruanda, the Baćwa, or Batembo, of the Province de l'Équateur north of Lake Leopold II, and sedentary or village Basúa, so-called, who live in four villages within the Ituri limits

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* Česká Akademie Věd a Umění (Académie Tchèque des Sciences et des Arts) Třída (Class) 2 Anthropologica Anthropologie Středoafrických Pygmejů v Belgickém Kongu (Anthropology of the Central African Pygmies in the Belgian Congo) Napsali P Šebesta a V Lebzelter Pp 143+66 plates. (Prague Česka Akademie Věd a Umění, 1933.)

The Bambuti, the pygmies proper, of the Ituri are not divided into tribes, but for linguistic reasons, they fall into three groups on the basis of the negro languages they have adopted These groups are the Aká, the Basua and the Éfé The Bambuti number in all about 25,000, distributed over an area of 123,000 sq km They are by no means on the decrease, though owing to the strenuous condition of nomadic life, infant mortality is high It would seem that the conditions of life are such that an approximate stability of population has prevailed for some considerable time The state of health of adults is excellent, and grey headed men and women are not rare

Though there is no race which at first inspection presents so many strange features as the Bambuti, there is no sign that they are a product of degeneration Though the body is remarkably short and clumsy, it is not stunted The average height for men is 146 cm and for women 133 5 cm The shortest woman measured was 118 cm She was the mother of six children Pygmy men of more than 150 cm are very rare

The heavy and clumsy appearance in build of the pygmy is due to the relative proportions of the body The head is disproportionately large, the neck short and the trunk disproportionately long Steatopygia is not marked The legs are short and thin and to a superficial observer suggest rachitis. The gait is heavy and clumsy, but in running swift and light-footed The knee shows marked projection of the patella The complexion in the more pure Bambuti is a greyish yellow The darker complexion, which is sometimes found, is probably due to negro admixture.

The conformation of the face is unique and in itself is sufficient to distinguish the pygmy from all other races Two types are recognised Of these one is long with a sudden narrowing of the lower part below the zygomatic arches, so that it ends in a pointed chin, the other is a round faced type, in which the cheek bones are less prominent and, probably, there is less prognathism The round projecting conformation of the forehead is striking It is especially noticeable, because there is almost no root to the nose The nose itself is very characteristic It is button shaped, and always broader than it is long It is a highly specialised form, for the study of which it was found necessary to devise a new technique The mouth is large and the lips thin Owing to the weakly developed receding character of the chin, the mouth has a markedly snoutlike appearance

The hair is either frizzled or spiral The latter is only half as frequent as the frizzled, but reliable data cannot be given as the Bambuti are mostly shorn There is a strong growth of face and body hair, but the growth of lanugo was observed rarely only, and then in women and only on arms and legs

There is very great variation in the details of the ear, and five types are distinguished It presents a general resemblance to negro or even European ears, but it differs fundamentally from the Bushman ear notwithstanding resemblance in certain features

There is evidence throughout the analysis of the anatomical data that in certain characters the pygmy is a highly specialised type Prof Lebzelter, in summing up his conclusions on the ethnological characters of the pygmies, distinguishes six types Pygmy Types I, II, and III, the Europoid Types, and Negro Types I and II Of the pygmy types, I and II are dolichocephalic and sub-dolichocephalic respectively, while III is brachycephalic with thinner lips and low face The Europoid Type is taller, with narrower face, narrow nose and thin lips, while Negro I is taller, with long skull, broad nose and thick lips and Negro II is brachycephalic, but otherwise has similar features

The distribution of these types shows that there are considerable differences within each tribe In the main, the Bambuti are of one race, with the addition of a small percentage of negroid and European elements

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Research and the Library

By Dr J L Berry, Lecturer in Physiology, and Dr. Wilfrid Bonser, Librarian,
University of Birmingham

THE enormous output of research to-day which finds its way into scientific and medical periodicals has produced a problem both for the research worker and the librarian The former finds it impossible to read everything now being published, and the latter finds the cost growing more and more prohibitive quite apart from the amount of shelf room required each year for housing

The recent campaign conducted in the United States and England against the exorbitant cost of German scientific and medical periodicals has resulted not only in a reduction in prices, but also in a reduction in bulk of the publications themselves. There has long been a well-founded complaint against the unnecessary amount of matter published, for the usual practice was to include in each article not only the original contribution to research but also a lengthy résumé of the whole subject, which was, or at least should have been, already known to readers The price reduction has been secured by the beneficial excision of this superfluous matter.

From our point of view, further reforms are necessary, and we put forward the following as conducive to clarity, economy of cost, bulk, and library storage room.

1 It has long been the practice of chemical journals to accept only new matter, and this cut down to the briefest account. This principle can be adopted with advantage in other scientific subjects The modern tendency of the young research worker to be judged upon the number of his papers rather than their quality swells the amount of printed matter. Ruthless editing of immature work and refusal of partial results of a research would lead to

the increased reputation of the worker which would be acquired by one complete and authoritative paper. Most journals do not make full use of their competent editorial boards, who must co-operate with the contributor and the publisher to attain this desirable objective.

2. Much space is occupied by a long list of references to previous authors, and many of these can be eliminated by a single reference to what we term a 'key paper'. Where a good paper on the subject with a full historical bibliography has already been published (for example, in *Physiological Reviews*, or a monograph) this could be quoted in lieu of repetition, papers subsequent to this only being cited. Such 'key references', in these days of specialisation within subjects, inflict no hardship upon the interested reader and would avoid the full list of references being given every time.

The 'key reference' would reduce the long preamble setting forth the reasons for undertaking the particular line of research, and would yield a concise statement of method and results.

Failing a ready made 'key paper', the complete and authoritative paper previously mentioned would thereupon automatically become the 'key paper' on that particular subject.

3. Abstracting journals are published mainly in English and in German, and it cannot be claimed that both are essential. Where a full abstracting service is available in one language (for example, in the *Ber. ges. Physiol.*) this should adequately cover the field and absorb or replace all others. It is no longer a valid excuse that German is not known by English speaking workers, as a working knowledge of both languages is part of a scientist's equipment.

If a full abstracting service does not exist for a subject, we recommend the excellent system adopted by the Royal Microscopical Society, which publishes, as an appendix to each part of its journal, abstracts from articles appearing in other journals on cognate subjects. If this practice were made a general one, a saving in bulk and binding would accrue. For example, the Physiological Society by printing its abstracts in the *Journal of Physiology* might (although slightly enlarging the size of the journal) eliminate its second periodical, *Physiological Abstracts*. If the Society did not adopt this procedure, which we term 'telescoping', it might save space by excluding all abstracts from articles in its own *Journal of Physiology*.

4. 'Telescoping' could usefully be employed in removing redundant publications. The *American Journal of Physiology* could coalesce with the *Journal of General Physiology*, the gain being the heightened standard of the articles.

Some societies, including the Royal Society of Arts and the Royal Society of Medicine, print papers *in extenso* in their journals when a résumé would usually be preferable: they also print *verbatim* the vote of thanks proposed by the chairman (the inclusion of which is tedious and unnecessary), as well as the ensuing debate. Excision of these would reduce the journals in question from unwieldy tomes to volumes of handy size.

The instructions for the reduction of bulk which were issued by the firm of Springer for their periodicals have already been abstracted in NATURE[1]: these might serve as a model in Great Britain and the United States.

University and Educational Intelligence

COLLEGE HALL, London, founded in 1882 to provide residential accommodation for university women students, has been greatly enlarged in the past four years. Its recently issued annual report includes a detailed account of the opening of the "Mary Brodrick" wing by H.R.H. Princess Alice on November 15. With this addition, the Hall is able to house 172 students. It fulfils an important imperial and international function in facilitating social intercourse between students from different parts of the Empire and from foreign countries. Its financial stability is, for the present, assured, but there is still a substantial debt to be cleared off, and the Council is especially anxious to do this at the earliest possible date so that it may increase the number of rooms let at reduced rates to impecunious students and build up a reserve fund for the purchase of the freehold of the site.

SECONDARY school problems in the United States are discussed in an article by Prof. D. Snedden, of Teachers College, Columbia University, in *School and Society* of February 16. The four-year high school, he says, tends rapidly to become a school for the whole of the population (9 millions) between 14 and 18 years of age. Already in 1934 two thirds of this population was in full time attendance. Except as regards what he calls their pseudo-vocational courses the high schools are still excessively under the spell of college entrance requirements. Changing family and economic conditions render increasingly profitless any serious vocational training begun before the age of eighteen or twenty years, and such vocational education as the high schools can offer is practically valueless. Hence an urgent necessity for devising high school curricula that shall enable these vast armies of pupils to be adequately prepared for finding themselves amid the modern world's welter of products of printing press, camera, phonograph, laboratory and shop. A few suggestions are offered, starting from the assumption that there must be at least three parallel sets of courses for the exceptionally gifted, the average, and the sub average pupil.

THE Carnegie Trust for the Universities of Scotland held its thirty third annual meeting on February 6. Among the outstanding events of the past year the report records the death of Lord Sands, its chairman since 1922, when he succeeded Lord Balfour of Burleigh. His place has been taken, since last July, by Sir H. Arthur Rose. Grants to universities and extra mural institutions are distributed by the Trust quinquennially, the last distribution, for 1930-35, having allocated £259,025, to be spent on libraries (£29,725), buildings and equipment (£184,600), and endowment of teaching and other general purposes (£44,700). Of the Trust's activities under its scheme of post-graduate study and research for 1933-38, the report observes that since awards were intimated last July, there have been many resignations on account of acceptance of salaried posts—a sign, it is hoped, of improved economic conditions in the country. Assistance in payment of class fees for 1933-34 absorbed £56,348, the number of beneficiaries being 4,017. Forty former beneficiaries voluntarily repaid to the Trust during the year sums amounting in the aggregate to £1,658, including a remittance of £300 from one whom the Trust had assisted to the extent of £100 only while he was a student in 1902-6.

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[1] NATURE, 132, 34, July 1, 1933.

Science News a Century Ago

Sir Charles Bell on the Brain

On April 30, 1835, Sir Charles Bell continued the reading to the Royal Society of his paper on the relation between the nerves of motion and of sensation and the brain The report of his paper said "The author enters into a minute anatomical investigation of the structure of the spinal cord, and of its relations with the encephalon, and with the origin of the nerves He finds that the spinal cord is constituted in its whole length, by six pairs of columns, namely, two posterior, two lateral and two anterior, each column being composed of concentric layers, and invested with an external coating of cineritious substance, and all the columns being divided from each other by deep sulci, which penetrate nearly to the centre of the cord On tracing the posterior columns in their ascent towards the encephalon, they are seen to diverge laterally at the *calamus scriptorius*, or bottom of the fourth ventricle, and to proceed *into the substance of the cerebellum* "

Quetelet's Natural Philosophy

Among the "Analyses of Books" contained in the Records of General Science of May 1835 is a notice of the "Facts, Laws and Phenomena of Natural Philosophy etc Translated from the French of Professor Quetelet of Brussels, with notes by Robert Wallace"

"For this translation," the notice ran, 'we are indebted to the industry of some young ladies in the vicinity of Glasgow Mr Wallace, the editor, states that having been called to give some lessons to some young ladies who were desirous of acquiring a knowledge of Natural Philosophy, he proposed that he should employ M Quetelet's work as a text book This proposal was adopted, the work translated, and the result of their labours is now presented to the public. It is extremely gratifying to see the tender sex not only enriching our books of science with their pencils, but actually studying something more than mere superficialities M Quetelet is concise in his statements of facts, of which the work forms a good digest The recent important discoveries in electricity of Dr Faraday have entirely escaped the notice of the author, but should have been introduced by the editor, as they include some very curious phenomena and constitute a very essential part of the science"

Gurney's Oxy-Hydrogen Light

"The Bude Light," said the *Mechanics' Magazine* of May 2, 1835, "is a name given by Mr Gurney (of steam-carriage abortion celebrity) to a new light which he has discovered, and so named after his new place of residence in Cornwall It is obtained by directing a stream of oxy-hydrogen gas on a quantity of powdered egg shells The light is represented to be 140 times greater than any of those now employed in lighthouses—so intense, indeed, that Mr. G lately stated to the House of Commons Committee on Lighthouses 'his belief that it would be possible to make his light, by certain management, point out the precise situation of a coast beacon to a ship three or four miles at sea, under circumstances of a fog so dense that no other light—not even the sun—could penetrate it to any distance'!"

Societies and Academies

Paris

Academy of Sciences, March 11 (*C R.*, **200**, 869–992)

Lucien Cayeux The conglomerate structure in lacustral medium in the old sedimentary series of France Richard Fosse, Paul De Graeve and Paul Emile Thomas The identification of small quantities of amino acids by elementary analysis. The method is based on the conversion of the amino acid into a hydantoic acid with potassium cyanate and condensation of this with xanthydrol Charles Nicolle and Mme Hélène Sparrow The weak pathogenic power, for small apes, of the murin virus I from rats at the port of Tunis J Cabannes and J Dufay The annual variation of the intensity of the bright lines of the night sky The results suggest that the polar aurora and the emission of the nocturnal sky may have a common cause Henri Lagatu and Louis Maume The kinematics of lime and magnesia and their physiological relation in the tobacco leaf Method of leaf relays Sylvain Wachs The reduced form of a quaternion unilateral linear substitution N Akhyeser and M Krein A quadrature formula of Tchebicheff Robert Meynieux The functional equations expressing the theorems of addition and of others more general Alexandre Dufour The possibility of deciding experimentally the difference between classical kinematics and relativist kinematics Z Horak The effect of the friction of pivoting on the shock of elastic bodies Simon De Backer Viscous fluids and waves capable of propagation Antoine Brun : The variable stars of the great nebula of Orion A list of ten new variable stars Victor Naggiar The production of threads and vortices in nematic liquids Jacques Solomon : The applicability of the principle of conservation of the moment of quantity of motion to nuclear processes N Thon . The constitution of the double layer and the trend of the curve of potential in the electrolytic neutralisation of metallic ions G Wataghin The thermal equilibrium of elementary corpuscles Léon Enderlin Study of the magnetic susceptibility of tetraphenylrubene and its dissociable oxide The magnetic measurements agree with thermochemical data and tend to establish that the oxygen of the dissociable rubene oxide is connected with the organic substratum by normal valencies This is a new argument in favour of the formula adopted for oxyrubene C H. Cartwright and J Errera . The intramolecular isomerism of α-picoline studied in the extreme infra-red. The hypothesis of the existence of the second tautomeric form of α-picoline is not confirmed by these researches André Charriou and Mlle Suzanne Valette The influence of alkaline iodides on the properties of photographic emulsions. René Audubert The sensibility of photon counters Jean Roulleau : The mechanisms of the photopotential of sheets of oxidised copper Léonard Sosnowski . The artificial radioactivity of iridium. The iridium was produced by the action of neutrons from beryllium irradiated with radium. The artificial radioactivity thus induced is fairly intense The results are not in agreement with those of Fermi. Henri Muraour and André Michel Lévy . The origin of the luminosities which accompany the detonation of explosives E. Duchemin . The influence of light on periodic precipitations in gelatinous media. The precipitation of silver chromate, phosphate and arsenate Charles Dufraisse and Marius Badoche The relations between the optical properties of the medium and the photochemical constants of tetraphenylrubene Study of the absorption spectrum The positions of the absorption bands vary with the nature of the solvent, but there is no evidence of the formation of any definite compound of the rubene with the solvent André Meyer and Mlle Madeleine Maurin Some reactional properties of 4 hydroxyquinaldine Clément Duval The coloration of cobalt salts Henri Wahl The chlorine derivatives of *p*-xylene Along with the 2,5 dichloroxylene already known, the 2,3 isomer is formed in the proportion of about 5 per cent The constitution of the latter has been established by synthesis Joseph Hoch A general method of synthesis of the nitrogen substituted ethylenic amines, R C CR′ NR″(Ar) Robert Levaillant The symmetrical sulphates of amyl, hexyl, heptyl and butyl The reaction used was that between a chlorsulphonate, $ClSO_3R$, and a sulphite, R_2SO_3, in the presence of a trace of zinc chloride as catalyst Charles Prévost The iodoargentobenzoic complex as agent of iodation, probable structure of the complex Pierre Bedos and Adrien Ruyer The constitution of Δ 3,4 cyclohexene-1,2 diol Some αβ-derivatives of adipic acid Georges Migeon The variation of the volume and the modifications of the network of the sepiolites as a function of the temperature Henri Longchambon The sepiolite of Ampandrandava (Madagascar) André Rivière New observations on the secondary of the Anti-Elbourz (Persia) Georges Deflandre The presence of microdiaclases in fragments of flint Their importance in the artificial coloration of microfossils, and in particular, Foraminifera Albert Robaux Extension of the formations of the upper Cretaceous, the Eocene and the Oligocene of the Flysch series in the south of the Province of Cadiz Louis Eblé and Gaston Gibault · The values of the magnetic elements at the station of Val Joyeux (Seine et-Oise) on January 1, 1935 Constantin T Popesco The undulatory movements in the leaves of *Dracœna indivisa* and *Alocasia macrorhiza* Raymond Poisson and René Patay *Beauveria doryphoræ*, a Muscardine parasite of *Leptinotarsa decemlineata* A. Paillot · Leucocytic nodules and various reactional processes in silk worms experimentally infected with *Streptococcus bombycis* Emile Haas The measurement of accommodative amplitude Emile Brumpt Paludism in birds *Plasmodium paddæ* of *Padda oryzivora* The utilisation of this parasite for chemicotherapeutic researches on paludism. Mlle Germaine Cousin The phenomena of neoteny in *Acheta campestris* and its hybrids Henri Nouvel The glycogen reserves in the Orthonectides Study of their evolution W Kopaczewski. Serum gelification by cancer-producing agents. Mme Marie Phisalix, Augustin Boutaric and Jean Bouchard The action of some snake poisons on the fluorescence of solutions of uranine Mladen Paić and Mlle Valerie Deutsch. The specific rotatory power, the rotatory dispersion and the polarimetric determination of the seric proteins. Georges Antoine · The presence of siliceous particles in animal tissues After destruction of the organic matter in various organs of man and animals, siliceous particles remain which the author regards as silica of interposition, of outside origin Mme Yvonne Khouvine. Study of some plant membranes. René Dujarric de la Rivière and Etienne Roux Has heavy water any action upon bacteria? The bactericidal action is very small, if any Louis Besson The influence of temperature and season on mortality Aristide Malherbe, Raymond Vilenski and Noël Herman Researches on the remnants of audition in deaf mutes Bone perception and its utilisation in teaching Mlle Dinah Ahragam The action of titanium on rats, carriers of Jensen sarcomas Injections of titanium compounds reduced the mortality due to the tumours

Leningrad

Academy of Sciences (*C R*, 4, No 8–9, 1934) L Kantorovitch A generalisation of the integral of Stieltjes K Evstropjev and N Sujkovskaja Influence of the composition of glass on the value of the phase potential V Juzhakov Migration of electrons from sodium into rock salt V Chlopin and A Samarceva Researches in the chemistry of polonium (1) Some compounds of bivalent polonium V Lukashevitch Sodium amalgam with traces of iron K Gorbunova and A Vagramian The passive state of the cathode M Poliakov Heterogeneous and homogeneous catalysis, $H_2 + O_2$ V Sadikov, R Kristallinskaja, H Lindquist-Rysakova and V Menshikova Effect of the temperature regime during the splitting of protein in an acetoclave upon the composition of the autoclavolysate R Belkin Interaction of the external and internal factors during ontogenesis in Amphibia (1) Influence of temperature on the metamorphosis of tadpoles of *Rana temporaria* produced by thyroxin The influence of temperature is more important than that of thyroxin L Polezhajev Determination of a regeneration K V Kosikov The attached *X*-chromosomes in *Drosophila simulans* E Hasratian The problem of the relation between the duration of the conditioned stimulus and the magnitude of the conditioned reflex V Novikov The problem of hardiness in seedlings of alfalfa varieties B Rubin and L Naumova Activity of enzymes as a varietal character V Trupp The problem of chemical processes in vegetables during storage A Vologdin *Archeocyathi* from the basin of the River Laba in the northern Caucasus Fresh finds of *Archaeocyathus* sp in the Caucasus confirm the existence of the Cambrian system in the lower sections of the Caucasian palæozoic strata N Soustov New data on the geology of the Khibiny district

Vienna

Academy of Sciences, January 31 Georg Koller and Hermann Hamburg (1) Constitution of *Diploschistes* acid This acid, which occurs in *Diploschistes scruposus* and *D bryophilus*, and gives a deep blue colour with baryta solution, consists of lecanoric acid and a second depside, $C_{16}H_{14}O_{8}$, built up of orsellinic acid and *s*-methylpyrogallolcarboxylic acid (2) A component of *Pertusuria dealbata* This component, a lichen acid of the formula $C_{19}H_{16}O_{11}$, proves to be thamnolic acid Erich Moll: Aerological investigation of periodic mountain winds in V-shaped Alpine valleys Otto Bankowski: Reciprocal replaceability of the hydrogen atoms of the co-ordination space of a complex salt and of water Richard Weiss and Ludwig Chledowski Formation of cyclic compounds from aromatic diamines by means of chloral Emil Abel, Otto Redlich and Walter Stricks Iodion catalysis of deuterium peroxide. The velocity constant of this catalysis at 25° is 1 13, those for HDO_2 and H_2O_2 being 1 19 and 1 57 respectively FRANZ KNOLL The Bruns-Hermite series in statistics

February 7 LEOPOLD SCHMID and SIGMUND MARGULIES Gossypol RUDOLF TOTH Stratigraphical observations on the trias chalk of the Hohen Wand region in Lower Austria VICTOR F HESS Criticism of Arthur Wagner's paper entitled "Critical Remarks on the Daily Course of Cosmic Ultra-radiation" HANS PRZIBRAM Lower males of the stag beetle, *Lucanus cervus*, L as heat forms LEONORE BRECHER Chrysalis coloration of the cabbage butterfly, *Pieris brassicae*, L and of *Vanessa Io and V urticae* H BOERSCH Determination of the structure of simple molecules by electron interference E BARONI and A FINK Investigations on the concentration of D_2O in natural ice F WERNER Reptiles of the [islands of the] Ægean Sea

February 14 H MANN A law of normal divisors KARL MAYRHOFER Partial fraction series FRITZ PRENN Dragon fly fauna of the Tyrol (biology of *Somatochlora arctica*, Zett and *S alpestris*, Selys) RICHARD WEISS and JOSEF EBERT Conversion of dialkylidenecyclohexanes into the isomeric dialkylphenols (1) Dibenzylidenecyclohexanone to 2 5-dibenzylphenol

February 21 HERBERT HABERLANDT, BERTA KARLIK and KARL PRZIBRAM Fluorescence of fluorite (3) Line fluorescence spectrum The spectra for different yttrofluorites and fluorites exhibit general agreement but individual divergences One yttrofluorite showed the blue europium bands, and with a fluorite from Weardale the Eu lines were strong in comparison with those of Tb With fluorites from Eastern Turkestan and Cornwall, the lines were intensified by radium radiation, the presence of very short lived centres being indicated WOLFGANG HOFF and FRANZ URBACH Attainment of a photochemical equilibrium with silver bromide ALFONS KLEMENC, RAOUL WECHSBERG and GEORG WAGNER Gas analysis methods for determining carbon suboxide in presence of carbon dioxide, carbon monoxide and oxygen Various methods, especially the use of fractional crystallisation at temperatures of about −100° C, were employed for separating these gases F ANGEL and OTTO FRIEDRICH Form of magnetite OTMAR ECKEL Radiation research in certain Austrian lakes FRITZ LIEBEN and STEPHAN MOLNAR Behaviour of the combination glycocoll-alcohol towards yeast which has been shaken with oxygen The amount of glycocoll taken up by the yeast is increased by the presence of alcohol, while the uptake of alcohol is checked when glycocoll is present

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Saturday, April 27

ROTHAMSTED EXPERIMENTAL STATION.—Conference on the "Swarming of Bees and the Practical Means of Controlling it".

Sunday, April 28

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30 —M. A. Phillips. "Mammals" *

Monday, April 29

BRITISH MUSEUM (NATURAL HISTORY), at 11 30 —G J Arrow "Horned Beetles" *

VICTORIA INSTITUTE, at 4 30 George H Kimble "The Expansion of the Habitable Earth in Old Testament Times"

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 – Prof G Barbour "Floods and Flood Control in China and America"

Tuesday, April 30

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP), at 7 – Dr Oliver C de C Ellis 'The Afterglow in Gaseous Explosions'

Thursday, May 2

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —Sir William Bragg "The Molecular Structure of Dielectrics" (Kelvin Lecture)

Friday, May 3

ROYAL INSTITUTION, at 9 —Sir William Larke "Iron and Steel"

IRON AND STEEL INSTITUTE, May 2–3 Symposium on the 'Welding of Iron and Steel" to be held at the Institution of Civil Engineers, Great George Street Westminster, S W 1

Official Publications Received

GREAT BRITAIN AND IRELAND

World Power Conference Annual Report, 1934 Pp 18 (London World Power Conference)

Forestry Commission Utilization Series No 2 Report on the Demand for Timber in Coal-Mining in England and Wales Pp vi+77 (London H M Stationery Office) 1*s* 3*d* net

Report of the United Kingdom Sugar Industry Inquiry Committee (Cmd 4871) Pp iv +123 (London H M Stationery Office) 2*s* net

The Archæology of Rochford Hundred and South-East Essex By William Pollitt (Museum Handbooks, No 7) Pp 59+22 plates (Southend on Sea Public Library and Museum Committee) 6*d*

University of Oxford Committee for Advanced Studies Abstracts of Dissertations for the Degree of Doctor of Philosophy Vol 7 (Dissertations accepted during 1934) Pp iv+129 (Oxford Clarendon Press, London Oxford University Press) 3*s* net

OTHER COUNTRIES

Ingeniørvidenskabelige Skrifter A Nr 18 Radiation from a Vertical Antenna over Flat Perfectly Conducting Earth By Dr P O Pedersen Pp 50 6 00 kr B Nr 12 Miscellaneous Papers By Dr P O Pedersen Pp 105 6 00 kr (Copenhagen G E C Gad)

Department of Agriculture Straits Settlements and Federated Malay States Scientific Series, No 16 The Toxic Value of *Derris* Spp By N C E Miller Pp ii+44+2 plates (Kuala Lumpur Department of Agriculture) 50 cents

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 52 Systematic Entomology—Contribution 1 i Notes on the Genus *Hexamera* B and B (Dipt Tachin), by A L Tonnoir, ii Australian *Hamitermes* (Isoptera), with Descriptions of New Species and hitherto Undescribed Castes, by G F Hill Pp 31+3 plates (Melbourne Government Printer)

Indian Forest Records Vol 20, Part 13 Results of Experiments on the Kiln Drying of Wood with Ozonized Air By Dr S N Kapur Pp ii+20 (Delhi Manager of Publications) 8 annas, 10*d*

British Guiana Second Legislative Council, Fourth Session, 1933 Geological Survey Department. The Kaburi District 1933 Progress Report By Dr D R Grantham, S Bracewell and Dr G J Williams Pp 22+2 plates (Georgetown Government Printers.)

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol 41, Fasc 3 Études sur la partie occidentale du Lac de Genève, 2 Histoire malacologique du Lac de Genève Par Jules Favre Pp 295–414+plate 13 (Genève et Bâle Georg et Cie) 10 francs

Ochrona Przyrody Organ Państwowej Rady Ochrony Przyrody Rocznik 14 Pp iv+235+4 plates (Kraków Państwowej Rady Ochrony Przyrody)

Proceedings of the American Academy of Arts and Sciences Vol 70, No 1 The Melting Curves and Compressibilities of Nitrogen and Argon By P W Bridgman Pp 32 65 cents Vol 70, No 2 Observations on the Behavior of Animals during the Total Solar Eclipse of August 31, 1932 By William Morton Wheeler, Clinton V MacCoy, Ludlow Griscom Glover M Allen and Harold J Coolidge, Jr. Pp 33–70 75 cents. (Boston, Mass American Academy of Arts and Sciences)

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 117 On the Motion of High-pressure Powder Gases and Compression Waves in the neighbourhood of the Muzzle of a Rifle By Kwan-ichi Terasawa, Mitsuo Tamano and Sin-iti Hattori Pp 489–492+9 plates (Tôkyô. Koseikai Publishing Office) 75 sen

NATURE

SATURDAY, MAY 4, 1935

No 3418 Vol 135

Tribute of Science to the Royal Jubilee

AMONG the addresses received by H.M. the King after his accession to the Throne on May 6, 1910, was one from the Royal Society, in which reference was made to the interest which His Majesty, when Prince of Wales, had continually shown in the progress of discovery and invention In consenting to succeed his father, King Edward, as Patron of the Society, King George expressed appreciation of these elements of national greatness, and assured the deputation of his "sympathy and support in your beneficent efforts for the promotion of natural knowledge" The collection of articles which appears in this special issue of NATURE, nearly all of which are by fellows of the Society, indicates some of the directions in which these efforts have been remarkably successful by adding new realms to the empire of science and conducting profitable explorations in them

Science, like the universe, has no natural partitions either in space or time; so that any record of its achievements cannot be limited to a particular period or country It happens, however, that the twenty-five years now being celebrated as the jubilee of the King's reign have seen a greater number of creative ideas in science than any corresponding period in the history of the world, and also that the contributions of British investigators to the rich harvest of scientific knowledge which has been gathered in are both distinctive and of supreme importance The articles outline some of the fertile fields of research opened up during the past quarter of a century; and it is impossible to read them without realising that we are living in a golden age of scientific discovery. The talents with which scientific workers have been entrusted have been used to full purpose; and the results obtained are worthy of both royal and national pride.

In the main part the results represent scientific researches undertaken purely with the view of revealing natural phenomena and discovering new relationships or interpretations of them This urge to penetrate into the unknown and reveal its mysteries cannot be repressed any more than can creative expression in art or literature When, however, the spirit of an age is sympathetic towards any such intellectual activities, their advancement is increasingly ensured On this account, acknowledgment must be made of the part played by the Department of Scientific and Industrial Research in the increase and use of natural knowledge The Department was formed during the War as the result of a memorial from the Royal Society and other scientific and technical societies, exactly twenty years ago, urging the Government to afford assistance "for scientific research for industrial purposes" Two years later, Parliament placed a sum of one million pounds sterling at the disposal of the Committee of Council for the promotion of industrial research, and since then the Department instituted by the Committee has devoted a large part of the funds it derives from the State to fundamental scientific research in universities and other institutions, as well as in the promotion of research directly applied to industry Two other national research organisations which have come into being during the past twenty-five years are the Medical Research Council and the Agricultural Research Council The former arose from the Medical Research Committee, which was appointed for the purpose of dealing with the money available for research under the National Health Insurance Act of 1911, and provision for organised research in agriculture may be said to have grown up from the Development Act of 1909

In addition to these and other endowments of research provided by the State since King George's accession to the Throne, there have been several munificent benefactions from private sources to establish research institutions or explore specific fields of investigation. On account of these extended facilities, the number of students and others engaged in scientific or industrial research has been multiplied many times during the past quarter of a century; and the output of original papers has increased to such an extent as to be unwieldy, and even oppressive, to scientific workers who desire to keep in touch with advances in their subjects Our own correspondence columns represent this stream of tendency on a small scale, yet they are but a rivulet of the broad and swift river which is bearing rich cargoes of new knowledge to peoples along its banks and to ports in the seas beyond.

To attempt to survey adequately the scope and substance of scientific publications of even a single week would be to undertake a hopeless task It is easy to understand, therefore, how incomplete any record must be which has to take a retrospective view of scientific progress in a period of twenty-five years Obviously the only practicable plan is to select for description subjects which have opened new epochs of scientific history during the reign of the King, and not to endeavour to summarise developments in various branches of the physical or biological sciences Beginning, for example, with the stellar universe, the knowledge gained during this period has led to entirely new conceptions as to its dimensions and structure, and their relation to the principle of relativity Coming down to the earth, the views now generally accepted as to its age and constitution differ substantially from those formerly held, and are based upon firmer foundations. From the planet earth it is a natural transition to the planetary microcosm of the atom Closely related are such subjects as isotopes, induced radioactivity, crystal structure, cosmic rays, the attainment of low temperatures, the constitution of the upper air, and weather forecasting As to man himself, new light has been thrown on his ancestry and the factors favourable to his healthy development or injurious to it, as well as on the problems of heredity involved in his future Chemistry is largely concerned with these and other biological problems, and has been able to give new aspects to them In applied science the discovery of special steels has been largely responsible for progress in many directions, and without them there could not have been the remarkable developments in X-ray apparatus, radio communication through the use of thermionic valves, aeronautics or turbine machinery These are the considerations which have decided the general order of the thirty articles now published.

The advances of knowledge have been accompanied by noteworthy changes of attitude of science towards philosophic and social problems. The implications of the theories of relativity and quanta, particularly in relation to notions of space and time, brought the physicist and mathematician into the realm of philosophy, while the philosopher has been giving attention to fruitful work in such specific problems as the nature of sense-data and their relation to physical entities, the character of space and time in their relation to one another, the basis of scientific induction, the interpretation of life and other intellectual concepts Modern physical interpretations of the nature of the universe have thus led to the discussion and development of associated metaphysical problems, and the two fields of thought are now regarded as complementary to one another

The view that the sole function of science is the discovery and study of fact, without regard to the philosophic or ethical implications of the knowledge gained, has undergone great modification in many minds It is realised that science cannot be divorced from ethics or rightly absolve itself from the human responsibilities in the application of its discoveries to destructive purposes in war or economic disturbances in times of peace Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the materials provided by them, and which their discoveries may be used to destroy. It is their duty to assist in the establishment of a rational and harmonious social order out of the welter of human conflict into which the world has been thrown through the release of uncontrolled sources of industrial production and of lethal weapons.

It would scarcely be appropriate to deal with these aspects of scientific progress in the present collection of articles, though they are likely to become of increasing importance in national polity and international adjustments We believe, however, that the wide range and high authority of the contributions now brought together in celebration of the silver jubilee of the King's reign are worthy of the occasion It would be easy, of course, to point to other subjects which might have been included appropriately in such a retrospective survey, but, on the other hand, it would have been most regrettable to omit a single one of the present contributions, and these by themselves would make a volume of reasonable size if published in that form instead of the pages of NATURE. The articles are offered as a tribute of loyalty from scientific workers to the King and Queen; and it is hoped that they will be regarded as a stimulating conspectus of advances in natural knowledge during a memorable twenty-five years

Twenty-five Years in History

By F S MARVIN

KING GEORGE'S reign will always be remembered in history for three, or rather four, unique events of world-wide as well as national importance It has contained the whole period of the greatest war in history and the more difficult part of the reconstruction which followed it It has seen the foundation of the League of Nations and its early growth It has witnessed an unparalleled economic depression from which we are now slowly recovering, and which we hope and believe His Majesty will survive to see completely overcome Lastly, in the sphere with which NATURE is more specially concerned, the King's reign covers the establishment of the most far-reaching transformation of our ideas of the material universe, for Einstein's ideas gained general acceptance just after the conclusion of the War

It is one of the ironies of history that the greatest of wars should thus be connected with the name of one of the most pacific of kings But there was not for a moment any doubt that the King fully sympathised with his people in all the four years of their trial, in spite of the family ties which connected him with the most formidable of their opponents After the War, one noticed a marked increase in the public affection and esteem for a man whose good qualities at first suffered somewhat from a comparison with the *bonhomie* and genial character of his father , and when, at the end of 1928, he was for a time laid low by a serious illness, it was clear that he had already won all hearts Time has only strengthened that position. He is so obviously the good and devoted man, ready to bear everything and do everything for the sake of others, and, above all, for the restoration of the country and its prosperity in peace.

Next to the War, the League of Nations is, of course, the largest political issue of the King's reign. In this matter the King was fortunate in his position, and better guided by political instinct than the contemporary head of the American Republic. He was able, quite impartially, to commend the League as a common interest to all his subjects, whereas it unfortunately became a party issue in the United States. In England, King George could ask all his subjects to give it their support, and, with the aid of Great Britain and the British Dominions, it has already attained considerable success. France too has been a loyal supporter; but, in the British Commonwealth, there was a league within the League without which the effectual functioning of the larger organisation is scarcely thinkable At the moment, the adhesion of Russia and the close co-operation of the United States do much to set off the temporary abstention of Germany and Japan The current year, which ushers in the King's jubilee, has seen several instances of the value of the League's work in carrying out the pacification of the world on lines entirely in accordance with the King's life-desire

The work of social reconstruction, of healing the wounds of war and making provision for a fuller life in future, is still upon us It was seriously aggravated, at about the time of the King's illness, by the bursting on the world of an economic depression which was as unparalleled in its severity as the War It does not fall within the scope of this article to discuss the causes of this or the remedies which are now slowly overcoming it Some of the difficulties no doubt are due to the fact that the resources of science in multiplying the productivity of the earth have for the time outstript our methods of distribution, and national barriers and new notions of national self-sufficiency have hindered the free circulation of the products But one thing relating to science and arising directly from the War falls to be noticed here The War stimulated scientific experiment on the mechanical, physical and chemical sides as it had never before been stimulated in history. The evil necessities of the time forced on work in the laboratory, in the forge and in the air which have had many not-evil results Civil aviation has largely profited from what our engineers devised and our pilots carried out mainly over the Western Front So also in the chemical laboratories, aiming for the time at the destruction of other men, an activity was developed which has since taken other directions The Department of Scientific and Industrial Research, which now conducts inquiries into many matters of permanent national concern, dates from this time It now has its own research stations and promotes the work of twenty-two industrial research associations One may quite truly —while earnestly desiring a further abatement in the manufacture of arms—consider that most of the swords forged for slaughter have since been turned into ploughshares and pruning hooks

So strange is the balance of good and evil in life that, while we were all, quite rightly, deploring the extinction of so many young and promising lights of science in the great catastrophe, science itself was taking some of its most prodigious strides forward

It will always be remembered in history that the same year which saw the Treaty of Versailles and the establishment of the League of Nations, saw also the confirmation of Einstein's theory of relativity in the eclipse of the sun in 1919. The greatest step towards the permanent peace of the world coincides with the greatest step towards the establishment of the most comprehensive physical conception of the universe. In that eclipse the apparent displacements outwards of the positions of stars in relation to the sun, as shown on photographs of the eclipse, were found to be consistent with Einstein's calculations and confirmatory of his special theory. From that time onward, what had been regarded rather as a private speculation of an eminent man, took rank as the leading conception of a new era of thought. It is now found at the root of all the physical speculations about the material universe which make the more recent part of King George's reign one of the most notable epochs in the history of science.

The new outlook comes home to us more closely at the time of national rejoicing, because so many English and Anglo-Saxon names stand on the record of the advance. Two—Jeans and Eddington—are household words. Within ten years of the confirmation of Einstein's theory, man seemed to have gained a closer insight into the physical constitution of the universe than all the previous centuries had offered. It was shown to be congruous with the nature of the atom as revealed in the laboratory. New lines of development were suggested by which the heavenly bodies had assumed their present form and light. A view was thus attained which looked into the future as well as the past, and knit together what had been thought of as an infinity of space, into the expanding mind of man. This new synthesis was intimately connected with Einstein's theories, and its application, in the interiors of the stars and the remotest recesses of space, was made possible by the extension of photographic and photometric methods. An alliance was set up between work in the laboratory and work with the telescope which has led to the latest discovery of a universal fundamental number, which Sir Arthur Eddington explains in his new book.

It was thought at first that the new views were a revolution, and that Newton was superseded. But Einstein himself never countenanced this conclusion. To him, Newton was merely corrected and supplemented, and new and old thought found their place together in one essentially continuous evolution. But no doubt a shock was given to the finality of Victorian science in more than one respect. The universe of matter was no longer a finite thing, enclosed within an infinity of empty space. It became an expanding finite, full and similar throughout. Moreover, whereas absolute certainty and precision seemed to be given by the old Newtonian synthesis, the new view, coloured by the quantum of Planck, introduced an apparent indeterminacy into the old and apparently rigid laws.

In another respect the progress of science in the new century does not follow precisely the programme anticipated in the nineteenth. Thinking then that the Newtonian synthesis was final, it was commonly expected that the twentieth century would see added to this accomplished fact, another, equally complete and final set of laws, co-ordinating the phenomena of life. Now, in spite of the enormous extension of biology, this attractive prospect has certainly not been realised. Mathematical thinking has gone on pervading wider and wider fields, and gaining the conspicuous triumph which Sir James Jeans has made familiar to all. But biology, though invaded by mathematics and though engaging a constantly larger army of workers, has reached no synthesis comparable to that of Newton for astronomical physics. It has become more and more dispersed and specialised. The Mendelian laws have been added to Darwin's, but the nature of heredity and the cause of variations remain still in the realm of eager inquiry and speculation rather than of ascertained truth. The immediate sequel both of Darwin and of Mendel was rather the setting men to think and examine the details more closely, than the drawing of conclusions from well-established principles. Not deduction, but increasing experiment and induction, are still the leading features.

During the War, a school of biologists began to be spoken of as 'neovitalists', of whom the best-known name is that of Driesch. They were opposed to the idea that, by pressing on the investigation of the physical and chemical conditions of life, we might ultimately grasp the origin and nature of life itself. Such work is, of course, being incessantly done, and is one of the most prominent features of the biology of the day. But the school of neo-vitalists maintains that life is a thing *sui generis* and that, however far we may explain its conditions, we can never explain *it*, any more than we can explain the fact of consciousness by analysing the components of our sensations. Bergson, the most famous philosopher of the period, gave powerful support to this school of thought by developing his conception of an *élan vital* on the psychological side. On the biological, it revived to some extent the idea of Lamarck that the living being stretched out in the direction of its advantage in life, and that the result of such efforts were transmitted by inheritance from one generation to another. Such transmission is at the moment denied by the majority of biologists, but a vigorous school of thinkers, finding their inspiration rather in philosophy than chemistry, are working to reconcile progressive work in biochemistry with the study of life in the concrete There are indeed signs that the rest of the century may come to justify the glowing prediction of the late Prof Patrick Geddes, that it would see the triumph of life and be the age of biology It is already true, in the more general sense, that men accept as a philosophical idea the community of all life and the development of higher forms of life from lower by some process in time which we have still to unravel

It would be well if one could speak of the acceptance of a community of human life on the planet with as much confidence as the growing consensus of opinion as to its origin In this matter, while the King's reign is distinguished by the establishment of the League of Nations, it cannot be said that the idea which it embodies or the practices which it exists to promote have made commensurate progress with what we have had to record of the progress of science. In some respects, there has been in recent years an actual setback Germany and Japan have renounced the League, and the United States, though helpful and friendly, has not formally joined even the Court of International Justice at The Hague Armaments have lately increased and no effective grouping or control of aviation has yet been effected There could be no more flagrant instance of the contrast between the unity of thought, which has given man his command of Nature, and the want of unity in his application of it, than this wanton rivalry in military aviation The most highly scientific means of transport and intercourse still threaten us as the most terrible method of mutual extermination, and the nations refuse an obvious resource to common action, common command, or even a common time-table for pacific purposes Nothing could better signalise the later years of His Majesty's reign, or be more in keeping with the master-spirit of the man whose life we prize and are now commemorating, than the conclusion of such an agreement It would be backed by all the scientific opinion of the world, and be the most striking proof of the progress of the reign in its essential quality—the pursuit of peace

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The Structure of the Universe

By SIR JAMES JEANS, F R S

IN the last quarter of a century, our picture of the astronomical universe has changed almost beyond recognition, and yet we seem to be standing only on the seashore of the great ocean of knowledge

The geocentric view of the structure of the universe became untenable for thinking men in the year 1610, but in 1910 many astronomers favoured a 'galacto-centric' view, believing that the galactic system was the central and dominating feature of the astronomical universe, with the earth very near to its geometrical centre

Sir William Herschel had shown that such stars as he could see in his telescope constituted a coin-shaped structure, the more distant stars combining to form the faint band of light we call the Milky Way. In the astronomical language of 1910, a few classes of objects—spiral nebulæ and globular star-clusters—were found to 'shun' this plane, but the majority—irregular and planetary nebulæ, blue and Wolf-Rayet stars, eclipsing and Cepheid variables—'favoured' it, ranging themselves about this plane like flies on the two sides of a fly-paper For this reason the plane of the Milky Way was thought to be fundamental in the structure of the universe.

So far back as 1755, Kant had shown that other views were possible, suggesting that the elliptical nebulæ were not "enormous single stars, but systems of many stars" similar to our own, but at so vast a distance that their light "on account of their immense multitude, reaches us in a uniform pale glimmer"

Herschel adopted this view, speaking of these supposed other systems of stars as "island universes". It fell into disfavour for a time, but Eddington, writing in 1914, remarked that "the hypothesis has recently been revived as regards the spiral nebulæ" He continued "It must be admitted that direct evidence is entirely lacking as to whether these bodies are within or without the stellar system".

Then Hubble found it possible to measure the sizes and distances of these objects, and the problem was solved. Certain standard objects are believed to shine with the same intrinsic luminosity wherever they occur in space, so that their apparent faintness at once gives a measure of their distance Among such standard beacon-lights are Cepheid variables of assigned period, long-period variables, blue stars of assigned spectral type, and novæ at maximum. Examples of most of these standard objects can be detected in the nearer nebulæ, and happily all tell substantially the same story as to the distances of these nebulæ. They tell us that the nearest nebula of all (M 33 in Triangulum) is about 800,000 light-years distant, while the second nearest (M 31, the Great Nebula in Andromeda) is at a distance perhaps about three per cent greater. This latter nebula subtends an angle of about five degrees in the sky, so that its diameter must be about 70,000 light-years. The diameter of our galactic system is generally supposed to be at least three times this.

Such measurements and studies have made it clear that these nebulæ are systems of stars like our own galaxy, that they lie entirely clear of this and are substantially smaller than it is. If we represent our own galaxy by London, then Birmingham and Bristol will represent the two nearest external galaxies fairly well in respect of both size and distance. A small nebula (M 32) which accompanies the Great Nebula in Andromeda may be represented by Wolverhampton or Coventry. Also two minor star-systems, the Magellanic Clouds, which lie so near our own galaxy (90,000 light-years from the sun) as almost to form part of it, may perhaps be compared to Croydon and Sutton. We must not place our sun in Central London, as Herschel imagined; rather we are out at Hampstead or Highgate, and see the lights of Central London and the smoky pall over it in the distance, when we look towards the great star-clouds and dark nebulæ of Sagittarius.

Most of these nebulæ show the same flattened shape as our own galaxy, and it has long been conjectured that this flattening must indicate rotation. Recently rotation has been discovered spectroscopically in a number of the nebulæ. The central part of the Great Nebula in Andromeda, for example, rotates with a period of about 16 million years, while that of the well-known nebula N G C 4594 in Virgo rotates about twice as fast. Quite recently Oort, Plaskett, Lindblad and others have found that the galactic system is also in rotation. The stars revolve much like the planets or the particles of Saturn's rings, the period of revolution increasing as we pass outwards. At the sun's distance it is at least 200 million years. This is 12½ times the period of revolution just mentioned for the Andromeda nebula, but it refers to a point six times as far out. If the whole of this latter nebula were concentrated in or near its centre, the rotation period at the sun's distance out would be about 235 million years, so that the rotations are at least comparable.

From these rotation periods, it is of course possible to calculate the masses of the nebulæ and of the galactic system. The nebulæ are found to have the masses of thousands of millions of suns, while the galaxy has a mass of 100,000 million suns at least. We see that our galaxy is something of a giant in mass as well as in size; if the nebulæ are island-universes, we still inhabit a continent.

As we proceed outwards into space, the Cepheid variables and other standard beacon-lights so far mentioned sink one after another into invisibility. Hubble has, however, found that nebulæ of assigned shapes and structure are themselves standard articles to a reasonably good approximation. Thus the faintness of the nebulæ themselves gives a measure of their distance, and it becomes possible to estimate the distances of even the faintest nebulæ, right up to the limits of vision of the telescope. The nebulæ prove to be distributed fairly uniformly at an average distance apart of perhaps 1,800,000 light-years.

If the matter contained in all these nebulæ were scattered evenly through space, the density would be of the order of 10^{-30} grams per c.c. This may give a clue to the mode of formation of the nebulæ, since a gas of this density would tend to condense into 'droplets' of just about the observed masses of the nebulæ. If nebulæ originated as such condensations in a fairly uniform gas, we have a ready explanation of the comparative uniformity of their sizes and structure.

When the light from any one of these distant nebulæ is analysed spectroscopically, the whole spectrum is found to be displaced homologously towards the red end. If we interpret these spectral displacements in the simplest way, as pure Doppler-effects, then these nebulæ are found to be receding from our galaxy at speeds almost exactly proportional to their distances—roughly, 105 miles a second for each million light-years of distance—and when allowance is made for the sun's motion through the galaxy, the same is found to be true of the nearer nebulæ also. In brief, the whole universe appears to be expanding uniformly, its linear dimensions increasing by one per cent every 20 million years.

It is likely that this apparent recession of the nebulæ is something more than a mere astronomical phenomenon, for the generalised theory of relativity seems to call for an expansion (or alternatively a contraction) of space itself. Thus the motions of the nebulæ may well be indications of something far more fundamental—a uniform expansion of the space in which they are imbedded.

The theory of relativity associates gravitation with a curvature of the space-time continuum; this is curled up in the proximity of matter, and the curvature shows itself in the curved paths of planets and projectiles. At one time it scarcely seemed possible that the whole curvature of the space-time continuum could be of this kind, for analysis showed that, if it were, space could not stand still; it would either expand or contract. To avoid this apparent absurdity, Einstein imagined the continuum endowed with a further curvature of its own, independent of the presence of matter and so inherent in the space itself. This was specified by a quantity, the 'cosmical constant', which was supposed to have a uniform value everywhere and so kept the total volume of space fixed and unalterable.

There is no observational evidence that such a constant exists, for the curvature it implies is too small for measurement. The constant was only introduced because Einstein had thought space must be at rest, and there is no need to retain it now that space appears not to be at rest. On the other hand, we are under no compulsion to discard it. Actually Einstein and de Sitter have found that the constant can have a large range of values, including zero, without running counter to any of the observed facts of astronomy.

We may compare space-time to a river having space as its cross-section and time as the direction of flow of its stream. Two dimensions are, of course, missing; the cross-section of our river ought to have three dimensions instead of one, but as all three are all exactly similar, the suppression of two of them does no great harm.

If space could remain constant in size, this river would become a canal with parallel banks; Einstein's original space-time river was of this type. But Friedmann and Lemaître showed that such a space would be unstable; any slight disturbance or irregularity—such as would, for instance, be caused by the condensation of a primeval gas into nebulæ—would start it either expanding or contracting. For this reason Lemaître thought that the Einstein canal should be replaced by a sort of Amazon River, starting from minute beginnings and for ever widening as it flows—expanding space. De Sitter found that other values for the cosmical constant made two other types of solution mathematically possible. In one of these the canal-like river gives place to a sort of Panama Canal—space first contracts until it reaches a minimum and then expands again to an indefinite extent. In the other, space rhythmically expands and contracts, so that the space-time river becomes a series of regularly spaced lakes connected by narrows.

The Amazon-like space-time river of Lemaître was open to one grave objection. Its length, which is time—the whole time since the beginning of the universe—was limited, and its source was nothing like distant enough to allow for the observed stages of development of stellar systems—in brief, the stars were too old to have grown up within the length of the river.

The two more recent solutions of de Sitter and Einstein are not open to any such objection, and at present either of them appears capable of providing a true, although highly artificial, representation of the observed phenomena of the universe. At one time, de Sitter was advocating the Panama canal type of map, while Einstein favoured the rhythmical universe of lake and narrows—a space which alternately expanded and contracted. Einstein now appears to contemplate the possibility of a zero cosmical constant and a space of infinite extent. But it is, I think, fair to say that no one is satisfied with the present position. It may be that still other alternatives remain to be discovered, and another few years may witness some new formulation of the problem which will lead to a satisfactory solution.

The New Age in Physics

By DR. H. DINGLE, Imperial College of Science and Technology, London

EVERY advance in thought has two aspects—the loss of the old and the gain of the new—and it is probably inevitable that, after the first flush of excitement has faded away, the former should become the more conspicuous. It may inspire joy at the passing of a delusion, or regret at the failure of an ideal: in either case it is the negative aspect of the change which protrudes itself, because all are conscious that what they believed in has gone, but only a few can at first see the significance of the new thing which has come.

This is exemplified by the fact, which is in all our minds to-day, that King George V has occupied the throne of England for twenty-five years. What does it mean? In 1910 we knew well enough what it would mean; but in 1935, who except a mathematical physicist will commit himself to an opinion? Twenty-five years to one observer, we are told, may be fifty years to another, and neither can claim superiority for his time-scale. Why, then, not celebrate a golden instead of a silver jubilee? The relativist knows, of course, that the destruction of absolute time is merely the necessary preliminary to the building of an absolute 'interval', and that twenty-five years is the *interval* during which King George has reigned. In this matter His Majesty's time is *proper* time, so that physics and patriotism support one another. But for one to whom this is the significant aspect of relativity, there are a thousand who know only that where they thought was certainty there is only confusion

It will not be amiss, therefore, to look at the positive side of the changes in physical thought which the past twenty-five years have seen. What principles have been introduced into science during that time, or having already existed there, have been more clearly understood and more rigidly applied ? How does this epoch appear against the broad background of scientific history ? What is the character of the tide as distinct from the wanderings of individual waves ? Only future historians can give final answers to these questions, but we may attempt to answer them in a manner fitted to the needs of our time

There seems little doubt that the essential contribution of relativity to science is the principle usually known as 'the rejection of unobservables'. It is not new in the sense that it has never before been applied : on the contrary, it is exemplified in almost every forward movement which physics has made But it has been used unconsciously, instinctively, and therefore to some extent inconsistently. It has now been brought into the light of day. That is the significant thing, beside which the consequences to our understanding of mechanics and gravitation are of secondary importance

It is very doubtful if this principle has yet been properly formulated, and quite certain that its full implications have not yet been grasped. It is probable, too, that it has on occasion been wrongly used. Though in appearance a merely negative principle, it is in fact a positive instrument of incalculable power We venture to suggest the following two statements as a provisional expression of its meaning :

(1) *The criterion of objective physical existence is general observability by physical means*[*].

(2) *In the logical correlation of experience, the concepts employed shall be such that whatever is not generally observable by physical means is necessarily meaningless*

Particular attention should be directed to the word 'necessarily'. It is not enough to reject unobservables : we must frame our laws of Nature so that they cannot arise to be rejected It is this that makes the principle an inherently positive one. Its first fully conscious application by Einstein illustrates this excellently. It is not sufficient merely to say that because it is impossible to observe motion relative to the ether, such motion is meaningless. We must define the concepts of space and time so that its meaninglessness is a necessary consequence. This Einstein did, and therein lies his greatness

So fundamental is this principle that some of its requirements are at present far beyond the possibility of practical application : they belong to the future Consider the age-old question : Does an object exist when no one is observing it ? The first part of our principle immediately answers, No : for clearly it is impossible to observe an object at a moment when no one is observing it. Consequently, our final physical terms must be such that the question has no meaning

Now the whole of what is known as 'field physics' necessarily involves existence without observation. Our observations are scattered, atomic, discontinuous, and we assume a continuum or continua (space, time, ether) in which they are distributed. Our field laws consequently describe realms of possibility rather than bits of actuality The law of gravitation does not tell us the structure of the solar system It gives us a prescription according to which an infinitude of solar systems might be built, but it cannot by its very nature tell us why we have our particular one Our principle requires that this form of theory must be discarded

Needless to say, the value of field theory as a means of advance is far from exhausted : it is its status as a possibly final form of scientific expression that is destroyed. Nor should this surprise us. A complete theory of the universe—that is, of all that is physically observable—can scarcely be pictured as a set of super-universal laws supplemented by an independent statement of how, from some quite arbitrary starting-point, a particular system developed in accordance therewith We should not be satisfied with any theory of the universe which did not give the details of the system equal inevitability with the laws according to which those details took shape We can, indeed, deduce this directly from our principle The universe cannot be regarded as one of a number of possible universes, because the others, being unobservable (our own comprises all that is observable), cannot exist Hence our final account of it cannot be in terms of field theory.

From this point of view it is highly significant that during this same period of twenty-five years the other great branch of modern physics—quantum theory—has been transformed from the heretical speculation of a few daring theorists into a system with claims to universal scope. Quantum theory, unlike field theory, postulates no unrealised possibilities ; it opposes discontinuity to continuity, and seeks to describe the actual rather than the possible. It provides the very soil in which the principle of rejection of unobservables would be expected best to flourish

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[*] That is, intrinsic observability ; for example, an object is not to be considered unobservable merely because one is not in a position to observe it.

The principle does flourish there, but again the result is generally seen more as a negative than as a positive achievement we are far less conscious of the growing fruit than of the lost blossom The supreme product of the quantum theory so far is described as a 'principle of uncertainty', and it is often regarded as having ousted causality from Nature It is worth while looking at this matter for a moment in its historical setting.

The idea of causality in its elementary form is almost as old as thought itself · intelligent action is impossible without an assurance that a given act will be followed by an expected event Only at a later stage of reflection is volition eliminated, so that the initial and final states of the physical system concerned are seen standing in causal connexion ; and it is still later that the conception is extended throughout space, the state of the universe at one instant being regarded as the effect of its immediately preceding and the cause of its immediately succeeding state This was the level of thought when Newton's laws of mechanics apparently placed the reality of the conception beyond question by discovering the clue to the inevitable succession of states Newton gave formulæ by which, if the position and momentum of each particle of matter in the universe at any one instant were known, its position and momentum at the next instant could be determined, and hence its position and momentum throughout all time, supposing it to be eternal.

Newton's mechanics has been modified in various ways, and the study of radiation, electricity and such phenomena has revealed a richer physical universe than that which he contemplated, but none of these developments has destroyed the possibility of prescribing the data necessary to predict the future course of events The fundamental modification of Newton's contribution to the idea of causality has come from the study of the means by which data are obtained Minute investigation shows that it is impossible to determine exactly the simultaneous position and momentum of any particle of matter because our means of observation are such that precision in one determination can be obtained only at the expense of precision in the other

It is important to see just what this means. In one sense it virtually puts us back to our position before Newton. We cannot state what are the data which would enable us to predict the future of the universe, but we may, as then, regard the predictability of its future as a generalisation of our experience of causality in limited systems of events. How far such generalisation is legitimate is indeed an important question, but it is not affected by recent work Galileo could have discussed it with us without being at much disadvantage. Furthermore, the experience of causality in limited systems is a fundamental fact. It is impossible that scientific developments can overthrow it without destroying their legitimacy, for it is their basis The sum and substance of the matter is that we have found that the data by which we thought we could forecast the future are unattainable

There is an important difference between this and the statement which is frequently made, that the quantum theory requires that an experiment can be repeated several times under precisely similar conditions with various results. If that were true, it would indicate an irrationality in Nature which would be the negation of science. What the theory does show is that, if we define similarity of conditions as similarity of positions and momenta of the physical systems concerned, we can never be sure that we *are* repeating the experiment under precisely similar conditions The distinction is profoundly important, for the actual situation leaves open the possibility that other data may be specified which will precisely identify a system, whereas the incorrect statement leaves no room for such a possibility

Now it is just at this point that our fundamental principle of rejection of unobservables comes in Since simultaneous position and momentum are unobservable, we must not only reject them, but we must also re-express our laws in terms according to which they have no meaning Position and momentum are functions of the continua, time and space, which are appropriate to field theory, but cannot be expected precisely to fit phenomena which are essentially discontinuous The problem of physics, then, is to devise other terms

That such terms are possible there seems little reason to doubt A useful beginning has been made with the concept of probability. This is expressed mathematically as a ratio of integers, and so is more appropriate to discrete phenomena than any kind of continuous extension It is sometimes said that we can no longer use models to represent physical conceptions. This, of course, is inaccurate, or physics would have no place left for the man with imagination ; it would be a sphere of action only for the robot What has happened is that mechanical models, which are spatial, have given way to epistemological ones, which are integral To regard this as anything but a step towards better conceptions is to miss the significance of the new enlightenment The error of the nineteenth century physicists was not that they used mechanical models (which were entirely appropriate to their stage of development), but that they did not recognise them as models. To imagine that probability has any greater claim to inherent permanency than mechanisms—and, in particular, to draw fundamental conclusions from the accident that probability suggests an intrinsic uncertainty—is to make the same error.

It seems likely that the quantum theory, so far from expelling precision from our description of Nature, really opens the door to it for the first time. For strictly speaking, a field theory can never allow absolute precision since continua are infinitely divisible. A particle having a co-ordinate represented by a non-terminating decimal, for example, could have its position specified as nearly exactly as we pleased, but not with absolute exactness, and an infinite future would hold the possibility of an indefinite amount of departure from a prediction based on such specification. Data which must necessarily be expressed in integers, however, are clearly susceptible of absolutely exact expression. The present position is therefore that we have escaped from a scheme of thought which made precise prediction impossible into one which, though we are as yet less far advanced in it, offers absolute precision as a possible goal.

Comparisons, if not odious, are liable to be misleading, and it would be unwise to stress them. Nevertheless, it may well be doubted whether in any previous period of twenty-five years, physics has experienced a more substantial forward movement.

Constitution of the Earth

By Dr. Harold Jeffreys, F.R.S., St John's College, Cambridge

COMPARING the position of geophysics now with what existed in 1910, while we are struck by the great development that has taken place, we are equally struck, on looking more closely, by the fact that most of the theoretical advances are due, not to specifically new methods, but to the fuller application of methods that were already known. The work of Kelvin and Sir George Darwin on the rigidity of the earth, and on the evolution of the earth-moon system under the action of tidal friction, was already classical; Darwin's theory of the stresses needed to support continents and mountains was thirty years old; the existence of isostatic compensation, and the two alternative explanations of Pratt and Airy, had been known for fifty years, Stokes's theory of the determination of the figure of the earth from observations of gravity for sixty, and Poisson's theory of the longitudinal and transverse waves in an elastic solid for eighty. Dr. C. Davison, still with us, had put the thermal contraction theory of mountain formation on a quantitative basis in 1887, and Wiechert had shown how to reconcile the earth's ellipticity and precessional constant on the assumption of a thick rocky shell surrounding a dense metallic core. The existence of a change in properties in the crust in the continents at some small depth had already been inferred from geological considerations by Suess.

The chief new advance in the first ten years of the present century probably arose from the detection of radioactivity, the recognition of its effect in modifying the earth's thermal history, and the use of the rate of disintegration of uranium to find the absolute ages of minerals and to calibrate the geological time-scale. The age of the earth, estimated from thermal considerations by Kelvin at about 20 million years, was suddenly raised to about 1,500 million. Physicists did not all accept the new estimate without a struggle, though purely mechanical considerations might have given some ground for doubting Kelvin's value. Darwin, by adopting such a viscosity in the earth as would make the changes through tidal friction occur at every time at the maximum rate, the viscosity thus varying with time in a way very unlikely to correspond to the facts, could not bring the age of the moon below 54 million years. This might have been taken as an absolute minimum that was practically certain to be greatly exceeded.

The new source of heat was so potent that the present Lord Rayleigh pointed out that, if it was not confined to a depth of some tens of kilometres at the outside, it would produce more heat than is escaping from the earth; consequently it led Holmes to estimate the rate of decrease with depth. It was found to suggest that average granite could exist only to a depth of about 15 km. and agreed in principle with the conclusions of Suess.

Meanwhile, seismology made three great advances. Herglotz and Bateman provided a method of finding the velocity of an elastic wave at any depth in the earth from the observed times of travel of earthquake waves, which was first applied by S. Mohorovičić in 1916. R. D. Oldham found that longitudinal waves arrived at the opposite side of the earth about three minutes later than they would if the velocities found from observations at shorter distances were maintained to the centre, and inferred that at a depth of about half the radius there was a change of properties involving a diminution of velocity. The radius found for the core in this way was substantially less than that found by Wiechert; but it was not until 1926 that it was noticed that the compression of each layer in the earth by the weight of the matter above it would raise the density so much that, when it was allowed for, the radii found by Wiechert's method and Oldham's were practically identical, so that the Wiechert core and the Oldham core are the same thing. A. Mohorovičić, working on a small earthquake in Croatia in 1909, found that the records at short distances could not be represented by a medium the properties of which varied continuously. They showed a pair of strong longitudinal and transverse waves, which were overtaken at a distance between 100 km. and 200 km. by a weaker pair that travelled faster; the latter corresponded to the waves observed at greater distances. The interpretation is that the strong pair observed only up to distances of about 800 km. travel in an upper layer, while the others travel with greater velocities through a lower region of great depth. The correspondence with the geological and thermal considerations is plain.

All these lines of investigation were greatly developed by Gutenberg, particularly in relation to the waves through the core and reflected by it. The reduction of the velocity of a longitudinal wave on entering the core is about that of light on entering water from air; consequently the core casts a shadow, which can be recognised by the absence of the clear direct waves beyond a distance of about 105° and their replacement by a vague diffracted movement, and the rays passing through it have a caustic surface, which meets the outer surface before it has come to a focus. Thus there is a narrow zone, at a distance of about 143°, where the motion in the longitudinal wave is extremely strong. The estimated velocities led Gutenberg to calculate times of transmission of many other core waves, notably those reflected at its outside, the wave that is transverse in the shell but is partly refracted as a longitudinal one in the core, and one derived from the latter by undergoing one reflexion on the inside of the core before it comes out. These were all recognised on actual seismograms. It was much later, however, that attention was directed to this work in Great Britain, and Prof. H. H. Turner rediscovered several of Gutenberg's waves independently from the observational material supplied to the International Seismological Summary.

The most immediate consequence of the existence of the reflected waves is that the boundary of the core is a sharp discontinuity of material and not a gradual transition. This gives a direct verification of the inference, based on a slightly dubious analogy with meteorites, that the shell is stony and the core mainly iron, with probably a certain amount of nickel. Further, the mean densities found by combining the radius of the core with the mean density and the moment of inertia are about 4·5 and 12 respectively; but if we estimate what they would become if the high pressures were taken off, they are about 3·3 and 8, the former agreeing with the density of olivine and the latter with that of iron. The core appears to be liquid. Gutenberg calculated what the times of transmission of transverse waves through it would be if it was solid, but though several workers have found movements that they have thought to be these waves, their results are not consistent and seem to be capable of other interpretations. The most direct evidence on the state of the core is provided by the earth's tidal yielding, which is practically what it would be if the core was fluid, and substantially more than if the core was solid and had a rigidity in any reasonable ratio to its bulk-modulus.

Further work on the records of near earthquakes has shown that there is at least one intermediate layer, and there may be three. The thickness of the upper layer is 12 km., with an uncertainty of 3–4 km.; the intermediate ones together may be twice as thick. The study of the surface waves, mainly by Stoneley, has given similar results with a rather higher precision. The surface waves under the oceans, however, show a different structure; the thickness of the upper layer is substantially less, and the geological evidence indicates that it is not granite there, but probably andesite or even basalt.

The chief modern contributions to seismological technique are probably the wireless time service and Bridgman's invention of a method of experimenting at high pressures. Until recently, the time had to be determined independently by astronomical observation at every station; now a station with no astronomical equipment can fix its time with as great accuracy as was possible to the best in 1910. The result of this and of the increase in the number of stations is that the times of transmission of the various waves can be determined, in most cases, with an accuracy of a second or less; in fact, the accuracy is so high that it has become necessary to allow for the ellipticity of the earth before we can make full use of it, and it has only been attainable because the earthquakes used have been in much the same latitude, so that the effect of the ellipticity has always been nearly the same.

Testing the compressibility of actual rock specimens at high pressures has shown that the velocities of elastic waves in the upper layer are consistent with its being granite, geologists seem to be coming to regard the upper layer as more like a granodiorite than a normal granite, but this is a minor change The lower layer fits olivine or dunite in elasticity as well as in density, it is definitely too dense and too stiff to be basalt, which, if it forms any extended layer at all, can only be the deepest and least clearly recognisable of the intermediate ones

A strong curvature near 20° of the curves representing times of transmission against distance was first noticed by Byerly, and work by I Lehmann, K E Bullen and myself has shown that there is a sharp change in the slope there This appears to correspond to an increase of the velocity by about 10 per cent at a depth of about 350 km The nature of this change is not yet understood Apart from the upper layers, this discontinuity, and the boundary of the core, there are no other sudden changes in properties with depth Search has been made for a sulphide layer, which has been expected to form the outermost part of the core, but it is necessary to do some violence to the observations to fit one in at all, and there seems to be no room for one more than a few kilometres thick at the most.

The study of gravity made a great advance in 1912 with the publication of Hayford's work in the United States, which showed that the larger mountain ranges of the United States are associated with such a defect of density below that the whole produces little disturbance of gravity Unfortunately this work, and the later work of Bowie, have suffered greatly from exaggeration and misinterpretation The general result was to assume that this compensation made a great reduction in the differences between observed and calculated gravity; but it did not abolish them. It was inferred by many that the approximate compensation was exact, and elaborate theories have been constructed upon it, assuming that it showed not only the lower layer, but even the upper ones, to be completely devoid of strength, in direct opposition to the plain fact that the surface of the earth is not perfectly flat Others, unwilling to accept the conclusion, have gone to the opposite extreme and denied that the observations imply any compensation at all It still does not seem to be generally recognised that a theory that reduces the average residual in a mountainous region from twenty times to six times the probable error of a single observation, is on a different footing both from a theory that reduces it to the mean error of a single observation and from one that does not reduce it at all On the other hand, the generality of the American results is not complete; they seem to apply to all the great mountain regions where they have been tested, but they break down in India and in the East Indies, as De Graaff Hunter and Vening Meinesz have shown

Meinesz's introduction of a method of determining gravity at sea by observing in a submarine is perhaps the greatest advance towards determining the figure of the earth accurately that has been made recently. Stokes showed how a complete knowledge of gravity over the earth's surface could give a determination of the external field, but so long as observations were available only over the land, and very limited proportions of that, we were in the position of trying to locate one end of a rod of unknown and variable curvature by observing a lot of points near the other. Now lines of observed values of gravity are available right across the main oceans, though there is still a great need for more in the southern hemisphere

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The Measurement of Geological Time

By PROF. ARTHUR HOLMES, Professor of Geology, University of Durham

TWENTY-FIVE years ago, opinions as to the scale of geological time were still in a chaotic state. The earlier controversy between Kelvin and the geologists had come to a dramatic end in 1906 with the discovery by Strutt (the present Lord Rayleigh) of the widespread distribution of radioactive elements through the rocks of the earth's crust. The earth could no longer be regarded as a spendthrift living on a limited capital of ancestral heat. An independent source of income had been disclosed in the energy liberated during radioactive disintegration, and henceforth no thermal argument could set a limit to the age of the earth. Already, however, helium and lead had been recognised as the end-products of the uranium family, and Rutherford had suggested (1905 and 1906) that the accumulation of these elements in radioactive minerals might provide a measure of the age of such minerals.

In 1907 Boltwood made the first attempt to calculate the ages of minerals which had been analysed for uranium and lead. During the next three years, Strutt carried out his far-reaching researches on the accumulation of helium during geological time and on its rate of production in uranium and thorium minerals. Thus, by 1910 the foundations were being actively laid on which our present knowledge of the subject has been built. It was evident from the preliminary results that the earth might well be fifty times as old as Kelvin had thought Geological evidence, based on a statistical comparison of rates of denudation with accumulated sediments on one hand, and with the salinity of the sea on the other, had suggested a period of about 100 million years for the age of the earth The possibility that 1,000–2,000 million years might be available seemed to many geologists to be as embarrassing as the former limitation to 20–40 million years Interest in the validity of the rival methods was thus reawakened, and most of the discussion of the last quarter of a century has rightly been focused on this fundamental aspect of the subject.

For reliable measurements of geological time we require to know (*a*) the rate at which some suitable process is going on at the present day, (*b*) the law of its variation during the interval to be measured, and (*c*) the cumulative change effected by the selected process during that interval

Except in their application to relatively short intervals, none of the geological methods fulfils these requirements Present rates of denudation are fairly well known over a wide range of environments, but there are many reasons for regarding their average as abnormally high compared with that of the geological past. River gradients are steeper than usual, because of recent mountain building, groundwater circulation is more active for the same reason, easily eroded blankets of glacial and fluvio-glacial sediments are widespread; and human activities—agricultural, engineering and chemical—have introduced a unique source of acceleration. Evidently no law of past variation can be formulated.

The total accumulation of sediments is difficult to estimate even approximately, since exposed sediments are worked over afresh by denudation, and deeply buried sediments may be metamorphosed beyond recognition by transfusion and granitisation Measures of maximum thicknesses provide comparable figures for the individual systems, but no corresponding rate of deposition is available, since the maximum thicknesses are really measures of crustal depression. If the sodium method of estimating the age of the oceans is apparently simpler in form and superior in quality, it is only delusively so, and not only because present rates of chemical denudation are high. The geochemistry of sodium is still insufficiently explored in two directions Sodium is probably returned to sediments by base exchange on the sea floor, and it is certainly added to them from plutonic sources by processes of albitisation and granitisation. The metamorphic cycle introduces incalculable sources of variation, but their effects are all in the same direction, so far as our problem is concerned All we can conclude is that the actual age of the oceans must be many times higher than the estimate calculated from present conditions

The radioactive methods are based on the generation of helium and of isotopes of lead from uranium, actino-uranium and thorium, and on the accumulation of these stable end-products in minerals, rocks and meteorites which have retained them The original uncertainties, which Becker and Joly never allowed to be overlooked, have now been completely dispelled Unless the contemporary state of scientific knowledge is as misleading in our day as it was in Kelvin's, we can now claim to be in possession of data that are securely founded in principle, and stable in the sense that continued research only increases their accuracy and extends their range*.

The present rates of production of helium and lead from uranium are well established ($\mathrm{U\,I} \rightarrow \mathrm{Pb}^{206} + 8\mathrm{He}$). To a first approximation, the age of a uranium mineral is given by the ratio of lead to uranium, (Pb/U), ×7600 million years But the investigations of von Grosse on the actinium series, and those of Aston and of Piggot and Allison, in recognising and disentangling the isotopes of lead leave no room for doubt that the actinium series springs from an isotope of uranium, AcU, and terminates in Pb^{207} ($\mathrm{AcU} \rightarrow \mathrm{Pb}^{207} + 6\mathrm{He}$) Thus, a slight error is introduced into the above formula, and this must be allowed for, especially in the case of old minerals At present, the ratio of AcU to U I is about 4 to 96, and the former disintegrates about ten times as fast as the latter Clearly the older the mineral the higher should be the ratio $\mathrm{Pb}^{207}/\mathrm{Pb}^{206}$, and hence this ratio itself constitutes an index of age

The chief defect in Boltwood's original use of lead-ratios only became apparent with the recognition that the thorium series also terminates in an isotope of lead ($\mathrm{Th} \rightarrow \mathrm{Pb}^{208} + 6\mathrm{He}$). For a thorium mineral, the corresponding lead-ratio can be expressed as $\mathrm{Pb}/k\mathrm{Th}$, where k depends on the rate of lead production by thorium relative to that by uranium. Strutt's early work showed that k was not far from 1/3. Later estimates have varied between 0·38 (Lawson) and 0·25 (Kirsch) In Bulletin 80 of the National Research Council, Washington, D C., referred to above, the value

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* A complete résumé of the subject up to 1931 appears in "The Age of the Earth", Bulletin 80 of the U S National Research Council, Washington, D C Since then a remarkable amount of new work has been accomplished, largely as a result of the direct influence and co-ordinating activity of the National Research Council Committee on the Measurement of Geological Time. The annual reports of the Committee, prepared by its energetic chairman, Prof A C. Lane, not only record the rapid progress which is being made, but also enable individual workers in various parts of the world to keep in close touch with each others' results and ideas.

0·36 was adopted by Kovarik and the writer, and more recent investigations by Kovarik, Ruark and Fesefeldt on the period of thorium have confirmed this value. For minerals containing both uranium and thorium, as many of the suitable minerals do, the simple lead-ratio (uncorrected for the actinium complication and the wearing out of the parent elements) thus becomes $Pb/(U+0{\cdot}36Th)$. The corresponding helium-ratio is $He/(U+0{\cdot}27Th)$. If helium is stated in cubic centimetres per 100 grams of material, the age of the latter in millions of years (provided there has been no loss of helium) is given approximately by multiplying the ratio by 8·8.

The question whether the rate of generation of lead isotopes and helium has varied during geological time has now been satisfactorily answered. None of the physical or chemical conditions appropriate to the terrestrial environment of radioactive minerals has been found to disturb in any way the normal rates of spontaneous disintegration. But this is not all. Positive evidence of the inferred constancy of rate is provided by pleochroic haloes, the rings of which correspond in radii to the ranges of the respective α-particles responsible for their development. The range of each α-particle is connected in turn with the rate of disintegration of its emitter by a simple law. Hence, if the ranges measured from pleochroic haloes in old Pre-Cambrian minerals are identical with those from Tertiary haloes and experimentally produced haloes, the chain of evidence is complete. In 1923, Joly claimed that the uranium ring showed a progressive increase of radius with increasing age. However, more accurate measurements by Kerr-Lawson in 1927 failed to reveal the alleged increase, and indicated that Joly's identification of the rings had been at fault. A recent study of haloes by Henderson, Bateson and Turnbull, in which a highly sensitive recording photometer was devised to measure the halo features, shows that there has been no variation of range, and therefore no change of rate of disintegration, over a period of a thousand million years. Henderson has also identified a ring due to actinium C and indicated how its development can be used in comparison with that of the radium C′ ring to yield estimates of age. Preliminary results are clearly of the right order.

The third condition of validity implies knowledge of the total accumulation of lead isotopes or helium in the radioactive material under investigation. To consider first the lead method: the presence of initial lead, if any, must be recognised and allowed for, and evidence is required that the mineral has remained uncontaminated by external influences since the time of its crystallisation. Field occurrence, microscopic examination, chemical composition, atomic weight determinations of lead, and isotopic analysis of the lead all contribute data bearing on these important points. After rejecting those numerous minerals which fail to satisfy the requirements, there still remain many for which the evidence of reliability is good. Assurance is confirmed when it is found (*a*) that minerals of the same geological age, but with varying values of U/Th, give concordant lead-ratios, and (*b*) that suites of minerals of varying geological age fall into an internally consistent time-scale. A good example of (*a*) is given by uraninite and monazite from a Pre-Cambrian pegmatite in Manitoba. Ellsworth obtained a lead-ratio of 0·260 from the first (a uranium mineral), while Miss Kroupa found 0·259 for the second (a thorium mineral), the corresponding ages being approximately 1,745 and 1,725 million years. To illustrate (*b*) the data set forth in the accompanying table will suffice.

AGE DETERMINATIONS BY THE LEAD AND HELIUM METHODS

Geological Age	Material	Locality	Millions of years from	
			Lead-ratios	Helium-ratios
Miocene	Uraninite	Mexico	35	
	Brannerite	Idaho	38	
Tertiary	Tholeiite	Cleveland Dyke, Durham		28
Eocene	Basalt	Deccan, India		37
Late Cretaceous	Kimberlite	Transvaal		58
	Pitchblende	Colorado	60	
Late Jurassic	Ishikawaite	Japan	128	
Triassic	Dolerite	Connecticut		170
Early Permian	Pitchblende	Bavaria	205	
Close of Carboniferous	Dolerite	Whin Sill, Westmorland		196
Upper Devonian	Uraninite	Portland, Connecticut	283	
	Monazite		278	
Late Ordovician	Uraninite	Fitchburg, Mass.	370	
	Cyrtolite	Bedford, N.Y.	380	
	Uraninite	Connecticut	380	
Upper Cambrian	Kolm	Sweden	455	
Late Pre-Cambrian	Basalt	Gwalior, India		500
	Basalt	Keweenawan, Lake Superior		580
	Pitchblende	Katanga	600	

The early applications of the helium method led to the conclusion that only minimum age determinations were possible on account of the leakage of helium from radioactive materials. Such loss is inevitable when the internal pressure of generated helium becomes high. In recent years, however, certain feebly radioactive substances, such as native metals and iron meteorites, have been found to retain helium completely, and fine-grained basaltic rocks also seem to be satisfactorily retentive. The technique for the determination of minute quantities of helium has been developed by Paneth to such a degree of precision that the amounts accumulated in iron meteorites and in basaltic rocks can now be accurately measured In 1929 the writer pointed out that "since igneous rocks suitable for the helium method are far more abundant and far better distributed in time than are radioactive minerals suitable for the lead method, there is now available a practical means of effecting long-distance correlations and of building up a geological time scale which, checked by a few reliable lead-ratios here and there, should become far more detailed than could ever be realised by means of the lead method alone" In the accompanying table some of the results which have since been obtained by Paneth, Dubey and Urry are listed

The oldest minerals so far reliably dated by the lead method are those of Manitoba, to which reference has already been made A similar age of more than 1,700 million years has recently been found for zircons from a South Dakota granite, which itself is older than the South Dakota uraninite analysed by Davis (1,465 million years) At least one cycle of sedimentation preceded the intrusion of these oldest known granites of North America, and by analogy with other such cycles, this would seem to indicate that the age of the earth cannot be less than 1,900 million years No approach to a closer estimate is practicable at present It is not improbable that a maximum limit may be set by the age determinations of meteorites made by Paneth and his colleagues The results range up to 2,800 million years, but while the origin of meteorites remains in doubt the significance of these figures remains speculative It appears possible, however, that the earth, the solar system and the present organisation of the stellar universe may all be of the same order of age, namely, 2,000–3,000 million years

To geologists, the exact age of the earth is of less importance than the application of age measurements to dating igneous rocks, correlating Pre-Cambrian formations in various parts of the world, and building up a reliable time-scale With the aid of the latter it is becoming possible to estimate the rates at which various geological processes have operated in the past It is already clear that, at least during the later part of geological time, there has been a remarkable acceleration of activity, and that during the Tertiary period, in particular, the earth was more vigorous in its behaviour than at any other time since the late Pre-Cambrian.

Atomic Physics

By THE RIGHT HON LORD RUTHERFORD, O M , F R S , Cavendish Professor of Physics, University of Cambridge

THE past twenty-five years has been a period of unexampled activity in physical science, and has witnessed a series of important discoveries which have widely extended our knowledge of the nature of the atoms and the interaction between matter and radiation. On looking back, we can see that the direction of advance was greatly influenced by three fundamental discoveries made at the end of last century—the discovery of X-rays, of radioactivity and of the electron The proof of the wave-nature of the X-rays in 1913 led to the development of simple methods for studying the X-ray spectra of the elements, and thus gave us important information on the arrangement of the electrons deep in the atom and their frequency of vibration. The study of the radioactive bodies had disclosed that they were undergoing spontaneous transformation and gave us for the first time an idea of the enormous forces which must exist within the structure of the atom. Sir J. J. Thomson early recognised that the electron must be a fundamental constituent in the structure of all atoms, and had devised methods for estimating the number of electrons present in each atom.

The nuclear theory of the atoms, based on experimental evidence of the scattering of α-particles by matter, belongs to the beginning of the period under review The proof by Moseley that the properties of an atom are defined, not by its atomic weight, but by its atomic or ordinal number, was an outstanding step in advance It was shown that the atomic number was a measure of the number of units of resultant charge carried by the nucleus and also a measure of the number of electrons surrounding the nucleus A relation of extraordinary simplicity was thus seen to connect all the elements—a relation which has governed all subsequent advances in our knowledge of the elements

The proof that the chemical elements are complex and in general consist of a number of isotopes of different masses was an important advance This conception, which we owe to Soddy, had its origin in the study of the chemical properties of the radioactive elements In the nuclear theory, isotopes represent atoms of identical nuclear charge but different masses. They should have the same chemical properties, apart from mass, and almost identical spectra Ashton showed in 1919 that the masses of the individual isotopes were nearly whole numbers in terms of O = 16. This whole number rule, while very convenient as a guide, is only approximate The accurate determination of the masses of the isotopes is of first importance, for it serves in a sense as a measure of the energy stored up in the atom and thus enters into all calculations which have to do with the transmutation of atoms

More than 250 species of atoms are now known, and even the lightest atom—hydrogen—has been shown in the last few years to consist of three isotopes of masses 1, 2 and 3 The isotope of mass 3 was first observed by Oliphant in transmutation experiments and has since been found to be present in ordinary hydrogen in about one part in a hundred million The discovery of the isotope of mass 2, now called deuterium, by Urey, has had important consequences, since it can readily be separated in a nearly pure state, and made use of in many physical and chemical experiments

This period has also seen the beginning and ultimate success of the application of quantum ideas to the explanation of the origin of the spectra of the elements, both X-ray and optical This wonderful advance, which we owe largely to the work of Bohr, is one of the most spectacular triumphs of this age Within less than a decade, the intricacies of the varied spectra of the elements were unravelled and explained along general lines. At the same time, there followed a complete understanding of the underlying meaning of the periodic table of the elements by taking into account the way in which electrons are grouped round a nucleus.

The application by Bohr of the quantum theory for the explanation of spectra was at first beset with many difficulties and ultimately led to the development of a new mechanics—the wave-mechanics—so closely associated with the names of de Broglie, Heisenberg, Schrödinger, Born and Dirac This has proved successful in giving an explanation not only of the complexities of the spectra of the elements but also of many of the most recondite problems of atomic physics. It has been applied to account in a general way for certain radioactive relations like the Geiger-Nuttall rule, while Gamow has utilised the theory to account for the artificial transformation of elements by particles of very low speed which on classical mechanics had no possibility of entering a nucleus.

The essential correctness of the ideas underlying the wave-mechanics has been verified by the direct experiments of Davisson and Germer, G. P. Thomson and Stern, by observing the diffraction effects produced by electrons and atoms when they fall on a crystal.

It will be seen that the past twenty-five years has been mainly occupied in an intensive study of the properties and structure of the atoms of the elements An enormous new territory of knowledge has been opened up and surveyed in detail. While the first idea of the quantum theory of radiation had been advanced by Planck in 1905 to account for the distribution of energy in the spectrum of a hot body, it was not until the period under review that the full significance and fruitfulness of the new conception was generally recognised It was early applied by Einstein to explain the photo-electric effect and by Nernst and Debye to account for the variation of specific heat with temperature, but its full importance was not realised until Bohr's work on the origin of spectra The interchange of energy between a quantum and an electron was made clear, while the interaction with an electron, which gives rise to scattering, was examined and explained by Compton on the quantum theory

Another strange type of interaction between radiation and matter has recently been discovered. When a gamma-ray of high quantum energy interacts with the intense electric field near a nucleus, the energy of the gamma-ray may be transformed with the appearance of an electron pair—one positive and the other negative Since the mass energy of the electron pair is about one million volts, this type of interaction only occurs when the quantum energy of the gamma ray exceeds this value The passage of high-frequency radiation through matter of high atomic weight is one of the simplest ways of producing positive electrons for study in the laboratory

Only brief reference can be made to two important problems which have occupied the attention of many investigators throughout the world during the last few years, namely, the cosmic rays and the transformation of matter. The existence of a very penetrating radiation in our atmosphere was first shown by Kolhörster, and the properties of this radiation have been examined by Millikan, Clay, A. H. Compton, Blackett and many others. When we consider the minuteness of the ionising effect of this radiation in an electroscope near the earth, much skill and technical ability have been required to make accurate observations often under difficult conditions. The investigations have been world-wide, and have involved measurements in deep water, on land and sea, on high mountains and at different heights in our atmosphere, extending far into the stratosphere.

It now seems likely that the main radiation consists of a stream of fast electrons both positive and negative possibly also protons with an admixture of high frequency radiation It is believed that some of the particles have energies so high as 10^9 volts and a few as high as 10^{10} volts —energies of a different order of magnitude from those to be expected from the transformation of atoms Naturally there has been much speculation as to the origin and nature of this extraordinary radiation which appears to come either from the confines of our atmosphere or from the depths of outer space The conditions under which particles can reach such gigantic energies constitute one of the outstanding unsolved problems of physics

While the natural transformation of the radioactive elements was made clear in 1903 the proof of the transmutation of many of the stable chemical elements by artificial methods belongs to the past quarter of a century The study of these transformations has been very fruitful leading to the discovery of three important entities in the structure of the atom—the proton neutron and the positron the counterpart of the negative electron of small mass

In order to produce a veritable transformation of an element it is necessary to change its nuclear charge or its mass or both together The chief method employed for this purpose is to bombard the element under examination by fast particles like protons neutrons or α particles Occasionally one out of a great number of these particles may happen to penetrate a nucleus and be captured by it The resulting nucleus may be unstable and break up with explosive violence hurling out a fast particle or particles and sometimes emitting high frequency radiation The residual nucleus may be either a stable element or an unstable element which behaves like a radioactive body The production of artificial radioactive bodies in this way by α particle bombardment was recently observed by M and Mme Curie Joliot

The first successful experiment on transmutation was made in 1919 when nitrogen bombarded by α-particles was found to be transformed with the emission of fast protons Rutherford and Chadwick found that about a dozen of the lighter elements suffered a similar type of transformation under the same conditions In order to extend these observations investigations were begun often on a large scale to produce intense streams of fast particles of different kinds to be used for bombarding purposes Cockcroft and Walton first showed that marked transformations could be produced in the light elements lithium and boron when they were bombarded by streams of fast protons accelerated in a discharge tube Lawrence, in California used an ingenious method of obtaining fast particles by multiple acceleration in a magnetic field and was able to obtain swift particles of energies as high as two million volts He found that the ions of heavy hydrogen of mass 2 were even more effective than protons in producing new types of transformation in a number of elements In some cases neutrons as well as protons and α particles appeared as a result of the transformations

The discovery of the neutron by Chadwick has proved of great importance not only in simplifying our ideas of the structure of nuclei but also as an extraordinarily effective agent in bringing about the transformation of many elements as was first shown by Feather and Harkins Fermi and his co workers in Rome made an important advance when they showed that neutrons could enter freely into the structure of even the heaviest nuclei in many cases leading to the production of artificial radioactive bodies which broke up at a characteristic rate with the emission of fast negative electrons More than fifty of these radioactive bodies are now known

By these transformation methods it has been found possible to build up heavier atoms from lighter to break some atoms into fragments and to produce radioactive isotopes in great numbers New and unsuspected stable isotopes of the elements like H^3 He^3 and Be^8 have been brought to light and gamma rays of much higher frequency than those from the natural radioactive bodies have been observed

The rapid advance of our knowledge of nuclear transformations has been in no small part due to the development of new technical methods of attack for example the automatic method of counting α particles and protons devised by Wynn Williams the Geiger Muller tube for recording positive and negative electrons and that wonderful instrument the cloud chamber devised by C T R Wilson The development of fast diffusion pumps by Gaede has made possible the rapid production of high vacua and the application of high potentials to discharge tubes

Our ideas of the structure of atomic nuclei are still in a very tentative state but it is generally believed that the proton and neutron are the primary building units The exact relation if any between the proton and neutron is still uncertain Some believe they are mutually convertible in a nucleus by the gain or loss of an electron and that even negatively charged protons may be formed Much more information is required before we can hope to reach a satisfactory explanation of nuclear structure and any detailed theory applicable to the nucleus is probably far distant

Isotopes

By Dr. F W Aston, F R S, Trinity College, Cambridge

THE subject of isotopes is particularly suitable for inclusion in this special issue of NATURE, for it is just twenty-five years since Soddy published the first valid proof of their existence The earlier speculations of Crookes and others had been found to rest on unsound observations. Discussing apparent chemical identities among the products of radioactivity, Soddy said "Chemical homogeneity is no longer a guarantee that any supposed element is not a mixture of several of different atomic weights, or that any atomic weight is not merely a mean number" The basis of his evidence was the law connecting radioactivity and chemical change, in the discovery and enunciation of which he played so prominent a part This law asserts that a radioactive element when it loses an α-particle goes back two places in the periodic table, when it loses a β-particle it goes forward one place It follows that by the loss of one α-particle followed by two β-particles, the atom, though weighing four units less, will have regained its nuclear charge and returned to its original place.

Such changes result in bodies to which Soddy applied the following words "The same algebraic sum of the positive and negative charges in the nucleus when the arithmetical sum is different gives what I call 'isotopes' or 'isotopic elements' because they occupy the same place in the periodic table They are chemically identical, and save only as regards the relatively few physical properties which depend upon atomic mass directly, physically identical also" Since the radioactive disintegration of uranium should result in lead of atomic weight 206, and that of thorium in lead of atomic weight 208, Soddy maintained that the lead found in uranium minerals should be lighter and that in thorium minerals heavier than ordinary lead, of atomic weight 207 2.

The idea that ordinary elements could consist of atoms of different mass received great opposition, for it appeared quite incompatible with such facts as the constancy of chemical atomic weight, the apparently perfect homogeneity of elementary gases, and the almost incredible invariability of such accurately measurable constants as the electrical conductivity of mercury independent of its source. Nor was it at first supported by the only available method of comparing the weights of individual atoms, Sir J J. Thomson's parabola analysis of positive rays, which was then being perfected, for such elements as hydrogen, carbon, nitrogen and oxygen gave only single parabolas. Neon, on the other hand, gave two parabolas, the one expected at 20 and a second fainter one at 22. Experimental evidence indicating partial separation of the hypothetical constituents of this element by diffusion was obtained in 1913, and when the War stopped work, there were several lines of reasoning suggesting that it consisted of isotopes, but none of those was sufficiently strong to carry conviction

During the War, Soddy's prediction concerning the atomic weights of leads from uranium and thorium minerals had been triumphantly vindicated by some of his most severe critics, the experts in chemical atomic weights, and it was realised that the most satisfactory proof of the isotopic nature of neon could be obtained by much more accurate analysis of its positive rays An instrument using a focusing device capable of a resolution of 1 in 130 and an accuracy of 1 in 1,000 was set up in 1919 by the writer and called a 'mass-spectrograph', a term which has now been extended to all devices capable of analysing mass-rays This instrument not only proved that neon was a mixture of atoms having weights, or mass numbers, 20 and 22, but also that chlorine consisted similarly of isotopes 35 and 37, and indeed that the majority of all elements were complex Thus krypton, the first element shown to be multiple, had six isotopes, 78, 80, 82, 83, 84, 86 Of the greatest theoretical importance was the fact that the weights of the atoms of all the elements measured, with the exception of hydrogen, were whole numbers to the accuracy of measurement This 'whole number rule' enabled the simple view to be taken that atoms were built of two units, protons and electrons, all the former and about half of the latter being bound together to form the nucleus

The analysis of the elements advanced rapidly, Dempster in America discovering the isotopes of magnesium, calcium and zinc by means of an instrument of his own design having magnetic focusing. By 1925, when the first mass-spectrograph was dismantled to be replaced by a more powerful one, information on the isotopic constitution of more than half the elements had been obtained. The new instrument was designed primarily for measuring the minute variations of the masses of atoms from the whole number rule, and had a resolving power ample for the heaviest elements. By its means the search for isotopes has been carried on until a few months ago

The difficulty of obtaining the necessary rays for analysis varies enormously from element to element Two main devices are employed the ordinary gas discharge which requires the element to be volatile or form suitable stable volatile compounds , and the anode ray discharge, in which the halide or other compound of the element is treated as the anode in a discharge at low pressure The inert gases are particularly suitable to the first method, the alkali metals to the second, other groups of elements being intermediate The largest group recently investigated was that of the rare earths These yielded to anode ray methods, and during the work some thirty new isotopes were discovered

From the point of view of the identification of the more abundant isotopes, our knowledge is nearly complete Of the more common elements all but four—palladium, iridium, platinum and gold—have yielded definite information on their isotopic constitution The resistance of these four is due to their chemical properties, which make the production of their rays peculiarly difficult In all, some 247 stable isotopes are now known, of which seven were discovered by observations on optical spectra, and have since been confirmed by the mass-spectrograph This large assembly shows many empirical laws, of which perhaps the most remarkable is that no odd numbered element, with the possible extremely rare exception H^3, has more than two isotopes Even elements are not so limited The most complex element so far observed is tin, with eleven isotopes ranging in mass number from 112 to 124 One of the most astonishing results is that, for practically every natural number up to 210, a stable elementary atom is known, many are filled twice over and a few three times with 'isobares', that is, atoms of the same weight but different chemical properties Schemes of tabulation of all the known species have led to the prediction of isotopes and to theories of nuclear structure to account for their occurrence

Instead of the original view that the nuclei of atoms consisted of protons and electrons, it is now considered more likely that they are built of protons and neutrons In either case the binding forces holding the particles together must represent loss of energy, that is, loss of mass. Hence it is that the atom of hydrogen has abnormally high mass, and that the accurate determinations of divergences from the whole number rule are of such profound theoretical importance As has been stated, my second mass-spectrograph was designed for this and found capable of an accuracy in favourable cases of 1 in 10,000. The atom of oxygen, 16, was chosen as standard and the percentage divergencies called 'packing fractions', were determined for a large number of elements These when plotted against mass number were found to fall roughly on a hyperbolic curve Our knowledge in this field has been notably increased by the brilliant work of Bainbridge, who, by means of a powerful mass-spectrograph of original design set up at Swarthmore, discovered new isotopes of tellurium, rectified results on zinc and germanium and made many of the most accurate comparisons of mass so far known

The relative abundance of the isotopes of an element can be measured in several ways, the most general being by photometry of mass spectra From this and the masses of the isotopes it is easy to calculate the mean atomic weight This with proper corrections can be used to check the chemical atomic weight During the past six years, nearly every atomic weight has been determined by this purely physical method, which has the great advantage of being, in general, independent of purity and requiring an almost infinitesimal quantity of material

The masses of the atoms H^1, C^{12}, N^{14} and O^{16} as determined by the second mass-spectrograph and published in 1927 agreed to 1 part in 10,000 with the accepted chemical atomic weights of these elements, but shortly after, observations on band spectra made by Giauque and Johnson showed the presence of heavier isotopes 17 and 18 in oxygen Their abundance determined by Mecke was such that the chemical unit of atomic weight O was about 2×10^{-4} greater than the physical one, O^{16}. Carbon and nitrogen were found later to possess heavier isotopes, and Birge pointed out that to satisfy the values hydrogen must have them also Urey took up the problem and, happily unaware of the real uncertainty in the figures concerned, with the collaboration of Brickwedde and Murphy fractionated liquid hydrogen and proved by examination of the Balmer lines that H^2 was present Washburn showed that its heavier atoms could be concentrated by electrolysis of water This method was developed so rapidly and brilliantly by Lewis that, soon after its discovery, pure 'heavy water' had been obtained in appreciable quantity

The isotope of hydrogen of mass 2 cannot be treated as a normal isotope Its exceptional difference in mass enables it to be separated with comparative ease in a pure state It has been given the name deuterium, symbol D, and heavy water (D_2O) is now obtainable in quantity at reasonable prices, one of the most surprising and interesting reagents in the whole history of science.

Induced Radioactivity

By Dr C. D. Ellis, F.R.S., Lecturer in Physics, University of Cambridge

It is just over a year since M and Mme Curie-Joliot announced that they had succeeded in producing radioactive atoms of low atomic number. In their first experiments they discovered that, when aluminium was bombarded by α-particles, a radioactive isotope of phosphorus was produced according to the reaction

$$_{13}Al^{27} + {}_{2}He^{4} \rightarrow {}_{15}P^{30} + {}_{0}n^{1}$$

The behaviour of this radio-phosphorus was quite analogous to that of the naturally occurring radioactive elements, except that instead of β-rays, that is negative electrons, positrons were emitted, resulting in the formation of a known stable isotope of silicon

$$_{15}P^{30} \rightarrow {}_{14}Si^{30} + \overset{+}{\epsilon}.$$

The half period of the radioactive decay was about 3·2 minutes

Similar results were found to occur using boron or magnesium instead of aluminium. With the ordinarily available α-particle sources, the amounts of these radioactive bodies that are produced is extremely small Even if all the α-particles emitted from the source are arranged to hit the aluminium, the resulting radioactive phosphorus will have only about one millionth to one ten-millionth of the activity of the source These small intensities are responsible for the main difficulties in the experiments, which would be impossible but for the delicate counting devices devised by Geiger

Since the initial discovery of the Joliots, other methods, as suggested in fact by them, of forming radioactive elements have been discovered Protons, deuterons and neutrons have all been found to lead to nuclear reactions which produce radioactive products. This is not the occasion to give a list of all the new radioactive isotopes that have been discovered. It will suffice to say that more than fifty have already been identified One important aspect of this may be noted Aston's work in furnishing a list of all the stable isotopes at least made possible speculations about the structure of nuclei—why certain combinations of protons and neutrons did occur and others did not. His later and more delicate work on the exact masses of the isotopes gave information about the energy of binding of these nuclei and provided a basis for quantitative theories Now, directly following from the Joliots' discovery, this field is suddenly enriched by a large number of new nuclei about which, by appropriate experiments, we may reasonably hope to obtain similar information Above all, this discovery must be considered as a remarkable extension of the possibilities of our knowledge

It is interesting to consider the relation of these new radioactive isotopes to the already known stable isotopes It is clear that certain combinations of protons and neutrons can form permanent nuclei The criterion of this permanency lies in the fundamental laws of interaction of proton and neutron, but the question whether a given nucleus is absolutely permanent or radioactive is connected with what might be termed the possibility of existence of neighbouring nuclei. Whether a given nucleus A is stable or radioactive depends, so far as our present knowledge goes, simply on the question whether the reaction $A \rightarrow B + C$ is endothermic or exothermic, B and C being other possible nuclei In practice, the only reasonable possibilities for C are proton, neutron, α-particle, electron or positron In the natural radioactive elements, C is either an α-particle or an electron; in the newly discovered radioactive elements, C is either an electron or a positron As yet, no case is known of induced radioactivity with emission of a heavy particle

In a general way, it is easy to see the factors which determine whether positrons or electrons are emitted Assuming that nuclei are built up of combinations of protons and neutrons, an examination of the list of the known stable isotopes shows clearly that permanently stable nuclei are only formed when the ratio of the number of neutrons to protons lies within a narrow range Isotopes with either a smaller or greater neutron/proton ratio do not occur naturally Now the addition of an α-particle (two neutrons + two protons) and the emission of a neutron is, in effect, an addition of one neutron and two protons, and means, therefore, a lowering of the neutron/proton ratio. If this ratio for the new element lies outside the stability range, the element will be radioactive, and the change will clearly be in the direction of raising the neutron/proton ratio. This can be effected by the switch of a proton into a neutron with emission of a positron On the other hand, if the initial absorption of an α-particle causes the emission of a proton, the situation is exactly reversed and a radioactive element so formed will emit negative electrons accompanied by a nuclear switch of a neutron into a proton. As an example of this latter process we may take magnesium bombarded by α-particles Magnesium has three stable isotopes and one of them undergoes the following reaction:

$$ {}_{12}\mathrm{Mg}^{25} + {}_{2}\mathrm{He}^{4} \rightarrow {}_{13}\mathrm{Al}^{28} + {}_{1}\mathrm{H}^{1}. $$

The aluminium isotope so formed is radioactive with a period of two and three quarter minutes, with emission of negative electrons.

The use of protons and deuterons to cause nuclear reactions leading to radioactive products has already been referred to but is of especial interest, since the intensity of the bombarding beams is here under control, and by sufficient technical application can be largely increased. Already Lawrence has produced a radioactive body in amounts comparable with that of the naturally occurring radioactive substances. A particularly interesting example is that of sodium bombarded by deuterons, when the following reaction occurs:

$$ {}_{11}\mathrm{Na}^{23} + {}_{1}\mathrm{D}^{2} \rightarrow {}_{11}\mathrm{Na}^{24} + {}_{1}\mathrm{H}^{1}. $$

This new isotope of sodium disintegrates under emission of β-particles with a period of fifteen and a half hours. The β-particles are not particularly energetic, having an upper limit of energy of only about one million volts, but an intense high-frequency γ-radiation of about five and a half million volts is also emitted. Using 1 microampere of 1·7 million volt deuterons for one hour gave already a two hundredth of a millicurie of radioactive material. This is an amount the effects of which can be detected by ordinary ionisation methods, and there is every reason to believe that it will be possible soon to increase the yield very greatly.

A great number of interesting investigations will be rendered feasible when it is possible to obtain in quantity a radioactive body such as this with a conveniently long period and emitting such high-frequency γ-radiation.

The most striking results, from the point of view of the number of new radioactive elements produced, have been obtained by Fermi, using neutrons as bombarding particles. The neutrons for these experiments are obtained by allowing α-particles to fall on beryllium, in practice by filling a small tube with beryllium and a certain quantity of radon. The number of neutrons is only about one hundred thousandth of the number of α-particles emitted by the source, but their efficiency in producing nuclear reactions is much greater. In fact, a large percentage of the neutrons which hit the nucleus produce an active atom. These experiments have also a far greater range than those using α-particles or protons, since the absence of charge on the neutron removes any distinction between light and heavy elements. The new radioactive isotopes formed in this way are spread fairly uniformly throughout the periodic table; for example, active bodies are formed from fluorine and magnesium, and also from thorium and uranium. In general, for light elements the process of activation consists in the capture of the neutron and simultaneous emission of an α-particle or proton. The resulting nucleus has then a higher neutron/proton ratio than corresponds to stability, and the necessary balance is re-established by the radioactive change of a neutron into a proton inside the nucleus with emission of an electron. For elements of higher atomic number, the chance of the initial ejection of a positively charged α-particle or proton is diminished by the stronger attractive field of the nucleus, and the initial process is more likely then to be just a simple capture of the neutron, again leading to an active nucleus with too high a neutron/proton ratio.

There are several points about the processes involved in the direct capture of a neutron which are not at present easy to understand, but it is plausible that the probability of capture should increase as the energy of the neutron is decreased. Fermi has in fact shown that the efficiency of production of some radioactive elements may be increased ten to one hundred times by surrounding the source and target by paraffin or water during bombardment. The primary neutrons emitted from the source are slowed down by elastic collisions with the hydrogen nuclei, and in this state are more easily captured by the nuclei of the bombarded substance.

Finally, as an example of the flexibility of these methods of producing new nuclei, we may consider the formation of a certain radioactive isotope of aluminium, ${}_{13}\mathrm{Al}^{28}$. This can be formed now in no less than five distinct ways, starting from different substances and using different bombarding particles.

Neutrons fired on to either aluminium, silicon, or phosphorus form this body according to the schemes:

$$ \begin{aligned} {}_{13}\mathrm{Al}^{27} &+ {}_{0}n^{1} \rightarrow {}_{13}\mathrm{Al}^{28} \\ {}_{14}\mathrm{Si}^{28} &+ {}_{0}n^{1} \rightarrow {}_{13}\mathrm{Al}^{28} + {}_{1}\mathrm{H}^{1}. \\ {}_{15}\mathrm{P}^{31} &+ {}_{0}n^{1} \rightarrow {}_{13}\mathrm{Al}^{28} + {}_{2}\mathrm{He}^{4} \end{aligned} $$

One can also use deuterons on aluminium or α-particles on magnesium, the latter reaction having already been mentioned in another connexion:

$$ \begin{aligned} {}_{13}\mathrm{Al}^{27} &+ {}_{1}\mathrm{D}^{2} \rightarrow {}_{13}\mathrm{Al}^{28} + {}_{1}\mathrm{H}^{1} \\ {}_{12}\mathrm{Mg}^{25} &+ {}_{2}\mathrm{He}^{4} \rightarrow {}_{13}\mathrm{Al}^{28} + {}_{1}\mathrm{H}^{1} \end{aligned} $$

In every case the same final product is obtained, which emits β-particles to form ${}_{14}\mathrm{Si}^{28}$ and has a period of about two and three quarter minutes.

X-Ray Crystal Analysis

By SIR WILLIAM BRAGG, O.M., F.R.S., Fullerian Professor of Chemistry, Royal Institution,
and Director of The Davy-Faraday Research Laboratory

THE development of the analysis of crystal structures by means of X-rays has fallen entirely within the period which the citizens of the British Commonwealth are now reviewing. Soon after the beginning of the present reign, a group of German scientific workers made the primary and fundamental discovery. But although the first step was taken abroad, the immediate and consequent advances were made in England, and throughout the whole twenty-five years British workers have taken a full share in the development of a subject which has now grown to extraordinary magnitude. The story of it falls happily, therefore, on the ears of those who now celebrate the King's Jubilee and consider the advances in knowledge which have been made during his reign.

The first experiments were made in Munich in 1912 and have been described in a fascinating manner by Friedrich, who helped to conduct them; his account is to be found in *Die Naturwissenschaften* for April 22, 1922. As has been pointed out by W. L. Bragg ("The Crystalline State", p. 271) the conditions in Munich at that time were peculiarly favourable to the event which gave rise to a new branch of science. Laue, a great mathematician, was profoundly interested in interference phenomena, and Sommerfeld, a great mathematical physicist, in the nature of X-rays and their excitation by the stopping of cathode rays, while Groth was the world's most famous authority on crystallography. The actual incident which precipitated the discovery was a doctor's dissertation by Ewald, who at that time had undertaken, under Sommerfeld's guidance, the study of the passage of light waves through a crystal, considered as a regular arrangement of scattering atoms. When discussing Ewald's problem, Laue was led to ask what would happen if the waves were so short that the wave-length was less than the interatomic distances in the crystal. He realised that spectra should be formed and that waves so short as to be diffracted in this way would be X-rays. An informal discussion on the possibility of observing this phenomenon took place after one of the colloquium meetings and Friedrich, who was then Sommerfeld's assistant, volunteered to carry out some experiments. Success came after several failures. Friedrich gives a vivid picture of his feelings when he saw the diffraction picture in the developing dish.

At that time the writer of this review was contending strongly that the X-rays must be regarded as corpuscular, if their general behaviour, and in particular their relations to cathode rays, were to be explained systematically. It did not occur to him at that time that undulatory and corpuscular theories could be held and worked simultaneously. Consequently, the new experiment seemed to be fatal to his views. It is now understood, of course, that the two theories must go in double harness, even if they do not always seem to pull together.

Naturally perturbed at the apparent contradiction, the writer suggested to his son, who had just completed his course at the University of Cambridge and was looking for a problem to attack, that he should study the new experiment and see if any reconciliation could be found. The conclusion that Laue was essentially correct was soon found to be inevitable. At the same time, it appeared to the young worker that Laue's explanation of the details of his zinc blende photographs was unnecessarily complicated. He found it simpler to approach the problem with the idea that electromagnetic pulses, equivalent to 'white light' in the X-ray region, were reflected from the crystal planes. This was suggested by the behaviour of the spots in the photograph when the crystal was tilted and by their shape. He was then able to draw certain conclusions as to the structure of zinc blende. This result was published in November 1912. The Laue photographs of sodium chloride and potassium chloride were found to be even simpler than that of zinc blende, so that all the details of their structures could be found. These two were the first crystals to be analysed.

Meanwhile, the writer at Leeds, and Moseley and Darwin at Manchester, examined the reflected beams of X-rays, using ionisation chamber and absorbing screens, and found that they had all the characteristic properties of the incident beam. From these researches came the X-ray ionisation spectrometer, which showed not only the 'white' radiation reflected over a wide range of angle but also the peaks of the characteristic line spectrum of the material of the target in the X-ray tube.

The discovery of the line spectrum had two results. In the first place, it made crystal analysis enormously more powerful. Several fairly simple structures were quickly solved by its means, such as zinc sulphide, iron pyrites, fluorspar and calcite. In the second place, the high-frequency spectra of the elements could be measured accurately. This led to the brilliant and well-known generalisation of Moseley who, by using an extended range of anticathodes, was able to formulate the laws relating frequency to atomic number. Moseley's death at Gallipoli in 1915 was a sad blow to the development of a new science

The outbreak of War in 1914 put an end to most of the researches in crystal analysis then proceeding. In the two short years great progress had, however, been made. The determination of crystal structure had begun. The ionic, or heteropolar, character of many crystals had been discovered. It is to be observed that in some of these early determinations the X-rays were called on for nothing more than a simple and ready decision between structures already suggested by other considerations. But the decision was final and very helpful The measurements of the intensities of the rays reflected from the various crystal planes had not yet come to play the important part that it does to-day. The measurements were used to determine the geometrical quantities of the crystal, the size of the unit cell and a few important data as to the relative positions of the elements in it Intensities were measured in certain cases, but no great accuracy was required Indeed, the technique was barely able to supply it. Moreover, there was the difficult question of the interpretation of the meaning of intensity measurements Darwin had, indeed, covered almost the whole ground of the theory of X-ray reflection. He distinguished between the perfect crystal, which is indeed a rarity, and the so-called 'mosaic crystal', which consists of an assemblage of small and more perfect crystallites, mutually aligned with greater or less accuracy. But his results were not put to their full use.

In some of the neutral countries work was carried on, and important results were obtained. In Sweden, Siegbahn developed a fine school devoted to spectrum measurements in which extraordinary accuracy was obtained. In Switzerland, Debye devised the 'powder' method which could be applied to the analysis of materials so finely subdivided that the crystalline character could not be observed even with the aid of the microscope. The crystalline character of colloidal suspensions, for example of gold, was a discovery of great interest. In America, Hull made use, independently, of the same method. The consequence of this advance was the inclusion of a vast number of substances, hitherto not recognised as crystalline, within the range of the X-ray analysis.

As soon as the laboratories could settle down to work again, after the War was over, the new subject was energetically studied all over the world and progress was rapid It was natural that in the first place efforts should be devoted to the task of shaping a new crystallography. The old had been founded almost entirely upon the external characteristics of crystals , the new gave insight into the body of the crystal and was obviously much more fundamental. The discoveries that had already been made gave promise of various useful generalisations, and these called for careful examination. Three main types of structure were to be recognised They may be illustrated from the work done before the War. There was the heteropolar type represented by rocksalt, in which ions were arranged so that each ion of one sign was surrounded by a certain number of ions of the contrary sign, all equally related to it. There was the homopolar type represented by diamond, in which the atoms were held together by the valency bonds of the chemist, now called co-valent bonds. In the diamond and other structures such bonds linked the crystal together into one whole. We know now that in most organic crystals only the atoms of each molecule are so linked together, the ties between molecule and molecule being the comparatively weak forces of Van der Waals Lastly, there were the metals such as, for example, aluminium, in which the atoms were held together by what may be termed an electronic cement.

In all these types one common and most important feature at once emerged The atoms or ions retained their characteristic dimensions in whatever structure they were embodied The first tables of atomic or ionic radii were drawn up by W L. Bragg, and in Finland by Wasastjerna. On these considerations Goldschmidt and his assistants reared a 'geochemistry' which showed how largely the various forms of crystal structure were governed by rules of geometry. To Niggli we owe the idea of a systematic deduction of the 'space-group' by means of X-ray data.

The most important constituents of the earth's crust are the silicates. Their immense variety of structure and chemical constitution had long presented an analytical problem which seemed to be insoluble by the older methods. W. L Bragg and his colleagues at Manchester have been successful in resolving their complications. The oxygen atoms, it seems, play a leading part in the structure. They form the bricks, laid as regularly as possible ; while the other constituent atoms, used somewhat indiscriminately, bind the whole together. In the course of this work it has been necessary to measure the intensities of the reflections from the various crystal planes, determining their values relative to the primary rays The electron distributions within the atoms also required evaluation, for which the theoretical work of Hartree and the experimental work of James and others proved invaluable. Also, at the University of Manchester a study of alloys has been very successful, Bradley's determinations of γ-brass and α-manganese leading the way At the present moment this branch of the subject is developing rapidly, by its means new insight is being gained into many metallurgical problems To the study of alloys, Westgren in Sweden contributed much pioneering work Another outstanding contribution has been Hume-Rothery's theory that the electron-atom ratio is a major factor in determining the type of an alloy structure.

Crystals composed of the complicated molecules of organic substances require special treatment if complete solutions are aimed at. It can be shown that every reflection which a crystal yields implies a harmonic variation of electron density, the magnitude of which corresponds to the intensity of the reflection. By measuring the absolute intensities of one or two hundred reflections, and summing up the implied harmonic variations in the manner of a Fourier series, a picture of the distribution of electron density is obtained The result is usually displayed in the form of a contour map, showing the densities projected upon some principal plane The atoms are clearly outlined and their positions can usually be determined with great accuracy. Very interesting determinations have been made in this way by J. M Robertson, Iball, Miss Knaggs in the Davy-Faraday Laboratory, by Wyckoff in America and others Here again there emerges a remarkable constancy in the distances between atomic centres · given a pair of atoms and the character of the bond, single, double or treble, the distance that separates them seems to be always the same, in whatever structure they enter In this case there is an added constancy in the orientations of the bonds in general: though in special circumstances variations may be forced upon them.

One of the most remarkable of the organic substances is the carbon chain which is the essential part of the paraffins, fatty acids, alcohols and the like. Its complete elucidation is due to Müller, Shearer and Piper in Great Britain, to M. de Broglie, Friedel and Trillat in France, and to others. The frequency with which the long chain appears in the construction of Nature is extraordinary and suggestive. It may be all of carbon, as in the cases just quoted: or it may include nitrogen as in the proteins, or as in cellulose it may consist of a series of linked rings each formed of carbon and oxygen

Some of the most remarkable investigations in organic substances have been made by Bernal, his subject being the vitamins and other biological structures. In this way the X-ray analysis is now contributing to biology

No one expected, when the new study began, that such a complicated substance as cellulose would have yielded to treatment but Mark, and Polanyi in Germany, and many others have found it possible to gain much useful information from the X-ray photographs, ill-defined as they are in comparison with those of crystals that can be recognised as such This work was, of course, inspired by the great importance of cellulose in many industries Later, Astbury, at Leeds, was able to solve the curious problem of the extensibility of keratin and other proteins He was able to show, for example, why wool is elastic and silk is not, basing his explanation on the determination of their fundamental structure. Recently he has explained in the same way the extensibility of nerve and muscle.

Naturally the determination of crystal structure has given a great opportunity to the mathematical physicist to formulate the laws which govern it, and to trace their actions The new system of wave-mechanics introduced by de Broglie and Schrödinger has been brought to bear, and much interesting work has already been done To this Born, Hund, Hückel in Germany, Hartree, Fowler, Lennard-Jones in England, Compton, Pauling and Slater in America, and many others in all parts of the world have made contribution.

Lastly, a word must be said in respect to the technical applications of X-ray analysis These have been many and varied. A section of the staff of the National Physical Laboratory under Shearer has been engaged in the study of various problems submitted by industry. A vast amount of research has been carried out in various places on the deformation of metal crystals, and the alterations in structure and properties due to cold-working. In this Polanyi has been the pioneer. In England, G. I. Taylor has been a chief contributor, while Gough at the National Physical Laboratory has concerned himself chiefly with the special question of the nature of metal fatigue.

This short sketch does but touch on a few of the principal matters that have formed part of the development of a subject now grown to very large dimensions; and it has only been possible to refer by name to a few of the many who have contributed thereto.

Low Temperature Research: Methods and Results

By PROF F. A LINDEMANN, F R S , Professor of Experimental Philosophy, University of Oxford

FEW branches of scientific research have developed more rapidly in the course of the last quarter of a century than the investigation of the properties of matter at low temperatures Twenty-five years ago such problems seemed of comparatively slight fundamental interest One knew, of course, that the electrical conductivity of metals increased with falling temperature Dewar had shown that the specific heats of solids diminished somewhat But no striking new phenomena were expected, and no exciting theoretical developments appeared likely to arise from research in these regions. Low-temperature work had gone out of fashion In Leyden alone, in the magnificently equipped laboratory of Kamerlingh Onnes, a series of elaborate and most accurate measurements of all sorts of properties of a series of substances attested that interest in this branch of knowledge was not extinct

As so often happens, it was from quite an unexpected quarter that interest in the subject was revivified In 1905 Nernst had enunciated his famous third law of thermodynamics, according to which, in any thermodynamic process, at the absolute zero the rate of change of affinity with temperature equals the rate of change of the heat content. To test this, the atomic heats near the absolute zero had to be ascertained, and to this end, with characteristic energy, Nernst turned over his Berlin laboratory to low temperature research. It very soon emerged, somewhat unexpectedly, that at low temperatures the atomic heats of all solids seemed to tend to zero. The kinetic implications of this discovery were far-reaching.

Already in the year 1900 Planck had enunciated his famous law of complete radiation. In order to derive this, it had been necessary to assume that linear oscillators obeying Maxwell's equations could only absorb or emit radiation in quanta the energy of which was proportional to their frequency But since it followed from Kirchhoff's law that the same law of radiation must emerge whatever the radiating entities, nobody had felt constrained to attach great importance to Planck's revolutionary presupposition. True, linear oscillators on his premises would lead to a law agreeable to experiment, but then no one really believed that the radiation from a hot body was due to linear Hertzian oscillators. Thus Planck's epoch-making assumption was treated with the comfortable indifference with which one slurs over the details of processes introduced in so many imaginary thermodynamic cycles

Even when Einstein pointed out in 1907 that the variation with the temperature of the specific heat of the diamond could be accounted for by applying Planck's premise to the atoms, it aroused little interest For the diamond had long been known to form an exception to Dulong and Petit's law, and one was accustomed to attribute the anomaly to polymerisation or some similar question-begging explanation

When it appeared that not only the atomic heat of the diamond, but also that of all solids, diminished at low temperatures, the matter took on a new complexion , and after it had been shown that the atomic heats of all simple substances when plotted against the temperature could be represented by the same formula, containing only one parameter characteristic of the substance, it became clear that, far from being a special assumption introduced in an imaginary case—unimportant, since any permissible imaginary process must lead to the right result—Planck's premise was a very vital physical fact

If actual atoms in a space-lattice held in position by their mutual attractions and repulsions could only take up or lose energy in quanta proportional to their frequency, then there must be something radically wrong with the whole basis of classical dynamics The atomic heat measurements at low temperatures seemed to prove the major premise , and though we have now learnt to express it in the form that there are only a finite number of distinguishable states within a given energy range for the atoms in a crystal, the minor premise has finally won general acceptance Differences may still exist as to the best way of introducing the quantum hypothesis. Nobody would to-day deny that some definite break with the classical point of view was inevitable.

Until 1933 the methods used for producing low temperatures were the same in principle as were used by Dewar, Linde and Hampson, and indeed by Cailletet and Pictet. The obvious way to cool a substance is to place it in thermal contact with a substance colder than itself Any substance will do, and it is clear that, in the first stages at any rate, a gas will be the easiest to cool , for to reduce the temperature we must slow up the motion of the molecules. There are two simple ways of doing this. The first is to let them collide with particles moving away from them. If a gas molecule is reflected from a fixed surface at the same temperature as the gas, its velocity on the average will be as great after the collision as before. But if the surface is not fixed but receding, the effective relative speed at the moment of collision will be reduced. Hence if gas molecules, instead of being enclosed in a vessel with fixed walls, are reflected from, say, a receding piston, their velocity will be lowered and the temperature of the gas will fall This is what happens when the temperature is reduced by the conversion of heat into external work The second method to cool a gas is to allow it to expand, that is, allow the molecules to recede from one another. If they naturally attract one another appreciably, this mutual attraction will tend to reduce their speed as they move apart, in other words, to reduce the temperature. This is the so-called Joule-Thomson effect which has been largely used in liquefying gases

A liquid gas produced by either of these methods, or a combination of the two, can be further cooled by pumping off the gas above the liquid. This causes more molecules to escape than return, and thus by doing work against the mutual attraction, as in the Joule-Thomson effect, tends to cool the liquid. A limit is set to this method of cooling, of course, by the fact that the vapour pressure diminishes exponentially with falling temperature. When the number of molecules which evaporate in unit time is so small that their latent heat just balances the inflow of heat due to imperfect insulation, no further reduction of temperature can be achieved By these means, using liquid helium and a battery of the most efficient pumps obtainable, a temperature of 0 7° was reached at Leyden by Keesom.

A totally different method, however, originally suggested by Debye and Giauque, has brought quite a new temperature region within our reach The entropy of a substance is a measure of its state of disorder. A set of molecules at rest in an accurate space-lattice would be in a state of complete order, that is, their entropy would be zero. As soon as their positions or motions vary, the entropy increases. Now paramagnetic salts contain atoms which behave like small magnets. Obviously, if their axes are all aligned parallel to one another, their positional state of order will be greater than when they are oriented at random. If we apply an external magnetic field, the axes of the magnetic atoms will all set themselves parallel to the lines of force. The entropy due to their positional disorder will therefore decrease; hence if the substance is thermally insulated, the entropy due to their thermal motion must increase; in other words, heat will be developed. Now if this heat is carried away, for example, by placing the substance in contact with liquid helium, and the substance is again thermally insulated, it is clear that one can cool the substance by reversing the process. For when the external field is removed the axes of the atomic magnets will tend, under the influence of thermal agitation, to resume their natural disordered condition, the positional entropy will increase at the expense of the entropy of agitation and the temperature must fall.

This effect was utilised by Giauque in California and by de Haas and Wiersma in Leyden in 1933 and by Kürti and Simon in Oxford in 1934 to cool substances to extremely low temperatures. Experiments in the region between 0·03° and 1° can be carried out without difficulty, and at Leyden, where a very strong magnet is available, a temperature of 0 005° has actually been reached. A great deal of work will have to be done before this method is fully exploited, as for each temperature range a suitable paramagnetic salt is required, but there is little doubt that by employing it in cascade or otherwise, extremely low temperatures will be as readily accessible to research as were temperatures a thousand times higher twenty-five years ago

The measurement of these low temperatures naturally presents quite a new set of problems. Down to 1°, of course an ordinary helium gas thermometer can be used, further, since all its constants are known, one can calculate the vapour pressure of helium and utilise this as a measure of the temperature down to 0 7° or even 0 5°. But at 0·1° the vapour pressure of helium is $10^{-[illegible]}$ mm. and at 0·03° it is $10^{-1[illegible]}$ mm. of mercury. Quite different methods must therefore be employed to measure such temperatures

Fortunately, one such method is ready to hand. The magnetic susceptibility of a paramagnetic salt is a measure of the ease with which the magnetic atoms can be oriented. The smaller the thermal agitation the more readily will they be directed by an external field. Thus, roughly speaking, the susceptibility will be inversely proportional to the temperature Obviously this rule is no more than a first approximation. Accurate thermometry will only be possible when the susceptibility curve has been linked up to the gas thermometer curve by means of proper thermodynamic cycles, a research now in hand at Oxford. Once this has been done, these susceptibility measurements will form a very convenient form of thermometry enabling an accuracy of 10^{-4} degrees or even better to be achieved.

Most of the phenomena at low temperatures have fallen into line with the predictions or at any rate the explanations of the quantum dynamics. The atomic heats of simple substances agree as well as can be expected with the theoretical expressions, especially when one remembers the difficulty of working out and weighting all the modes of oscillation of a space-lattice of atoms or even complicated molecules. The atomic frequencies calculated from elastic constants agree with those derived from the atomic heat curves; even the fine structure in the spectral lines due to nuclear spin is mirrored in anomalies in the specific heats at the calculated temperatures Quantum considerations, as Simon showed, enable one to understand the curious fact that helium remains liquid, in the sense that it has a very low viscosity, down to the lowest temperatures, though there is a point at which a certain order tends to be established. For with liquid helium the zero point energy is so great that at atmospheric pressure the substance can never become solid. If the pressure is raised, it can be reduced to the crystalline state even at temperatures ten times as high as its boiling point.

There is, however, one phenomenon, and that a very striking one, that has so far defied adequate explanation. In 1913 Kamerlingh Onnes announced that when mercury was cooled below 4° its electrical resistance vanished Supra-conductivity, as this effect is called, was afterwards found to occur in lead, tin and a number of other metals, though not by any means in all, for example, not in copper as low as 0·05°. Even some semi-conductors exhibit the same property, such as niobium carbide—indeed in this substance supra-conduction sets in at the highest temperature so far observed, namely, 12°. All attempts to observe some trace of electrical resistance in the supra-conducting state have failed. A current induced in a ring of supra-conducting material continues to run with undiminished strength for days on end. The phenomenon does not seem susceptible of explanation by any of the ordinary theories of electron conduction

Much work has been done in Leyden, Berlin, Toronto and Oxford on this strange effect, and the somewhat complicated phenomena are gradually being disentangled But whether it will be possible to fit it into the general scheme or whether it may not require some new mode of approach it is too early yet to say.

Though more low temperature research has been carried out in the last twenty-five years than in all preceding periods put together, and though temperatures within one hundredth of a degree from the absolute zero have been attained, there is no question of our having reached finality

Our nearness to the absolute zero is apparent rather than real; if we had chosen to measure the temperature on a geometric rather than an arithmetic scale, it would have been less convenient in many ways; but it would have made it clear that, towards low temperatures, as towards high, there is always an infinite distance ahead of us, and in each such range we may expect new effects and new phenomena.

Fortunately, there are within the Empire laboratories where these effects can be studied. At Oxford, Cambridge and Toronto, work at liquid helium temperatures and below is being done It may be hoped that the next generation will see the position of pre-eminence enjoyed by England in Dewar's time recaptured, and that advances as valuable and important as those which have signalised the past quarter of a century await us in the next.

Cosmic Rays

By DR. ARTHUR H. COMPTON, University of Chicago, and George Eastman
Visiting Professor in the University of Oxford

THE twenty-five year period of King George's reign includes almost the entire history of the study of cosmic rays. The presence of these rays was revealed by a series of experiments carried on between 1909 and 1914. Wulf, on the Eiffel Tower, and Gockel, flying in a balloon to 4,500 metres, found that rays from radioactive sources in the ground could not account for the ionisation observed at high altitudes, and suspected some radioactive material in the upper atmosphere[1]. Hess, in a series of notable balloon flights, found an actual increase of ionisation with increasing altitude, and concluded "that a radiation of very high penetrating power enters our atmosphere from above". These experiments were at first criticised by other investigators, but were quickly confirmed by the more precise observations of Kolhörster, and have since been found correct in all their essentials.

After eleven quiescent years, Millikan made some bold speculations regarding the origin of these penetrating rays, which showed in a striking manner that their study might well give important new information regarding the evolution of the universe. Largely through his experiments and those of Hoffmann, the existence of the radiation was by this time generally recognised, and an intensive series of investigations was started by many physicists throughout the world It was found that the rays which Hess had discovered are of a far more penetrating kind than any known before, being perceptible to a depth of hundreds of feet below the ground They bring into the earth a total amount of heat somewhat smaller than that of starlight; but the energy of the individual cosmic ray is thousands of times greater than the most powerful artificial ray that man has produced The more recent studies have sought to learn the nature of these rays, where they come from, how they are produced, and what effects they have on objects which they strike

NATURE OF THE COSMIC RAYS

It was at first natural to suppose that these highly penetrating rays were of the same nature as the γ-rays from radium, the most penetrating rays then known Though this view has not been entirely abandoned, the large majority of investigators now believe them to be electrically charged particles This view of their nature was first urged by Bothe and Kolhörster, who found associated with the cosmic rays some electrical particles which were as penetrating as the cosmic rays themselves They noted further that if such electrical particles approach the earth from all directions, some of those near the equator should be so deflected by the earth's magnetic field that the intensity of the rays should be less there than near the poles Through the experiments of Clay and many others, the existence of such a 'latitude effect', which depends upon the earth's magnetic field just as the theory predicts, has at last been established This has proved the existence of an important component of the cosmic rays which is electrically charged

More recently, using methods developed by Piccard, Regener and others, it has been possible to extend the measurements of cosmic rays high into the stratosphere Typical data taken at different latitudes are shown in Fig. 1. Here it will be noted that the latitude effect, which is only 15–20 per cent at sea-level, has become a factor of 40 near the top of the atmosphere. That is, nearly all the incoming rays are affected by the earth's magnetic field, and are hence electrically charged. Even of the small percentage which penetrates the magnetic barrier at the equator, supplementary experiments show that a large fraction and perhaps all is electrical in character[1,2].

A method of analysing the various electrical components has recently been developed[1,3], in which the earth is used as a huge natural mass-spectrograph, similar in principle to the laboratory instrument for identifying the isotopes of elements. The earth's magnetic field permits only those particles to reach the earth which have an energy, and hence a range in air, greater than a certain minimum This minimum range is different for every type of particle. Analysis of such curves as those shown in Fig 1 has enabled us to distinguish three groups of rays having distinct range minima Best agreement between these observed minimum ranges and those calculated from the earth's magnetic field is found if the least penetrating group of rays is identified as α-particles, that of medium penetration as electrons (positive or negative), and the most penetrating ones as protons

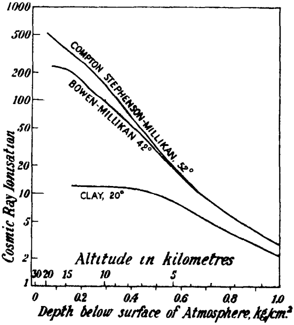

FIG 1 Cosmic ray ionisation at different altitudes as observed at different geomagnetic latitudes, showing great latitude effect at high altitudes

It is possible that this analysis may require revision as the result of further measurements, the method, however, seems adequate to supply a definite identification of the components of cosmic rays as soon as sufficiently precise data are available In the meantime, other observations, especially the directional experiments of Johnson, Alvarez, Rossi, Clay and others, lend support to this tentative analysis[4]. Rapid progress is thus being made toward a complete determination of the composition of cosmic rays.

WHENCE COME THE COSMIC RAYS ?

One of the most significant aspects of the latitude effect is its implication that the cosmic rays originate far beyond the earth's atmosphere. The earth's magnetic field is not strong enough to bend appreciably any radiation produced within the atmosphere before it is stopped by collisions with molecules Furthermore, the cosmic ray intensity is found to depend upon the average magnetic effect of the whole earth, and to be almost unaffected by 'local' magnetic idiosyncrasies which may extend even over a whole continent This must mean that they feel the effect of the earth's magnetism when yet thousands of miles from the earth's surface.

Except for deflection by the earth's magnetic field, however, the cosmic rays are found to approach the earth nearly uniformly from all directions. Outside the earth's atmosphere, we fail to find any isotropic distribution of matter within our galaxy where such rays might originate The extra-galactic nebulæ or space itself would, on the other hand, satisfy the condition of spherical symmetry Calculations by both Eddington and Lemaître have shown that the probable absorption of a cosmic ray traversing the matter in interstellar space with about the speed of light for 10^{10} years would be wholly negligible If, however, these rays are subject to the same red shift as that which occurs in the light from the distant nebulæ, the rays originating at distances as great as 10^{10} light years would arrive at the earth with only a small fraction of their initial energy If the rays are being continuously produced, therefore, their isotropic distribution suggests that most of them originate in the remote galaxies or in remote space, at an effective distance of between 10^9 and 10^{10} light years An alternative would be to suppose with Lemaître that they were formed at the beginning of the expansion of the universe, and have ever since been coursing through space

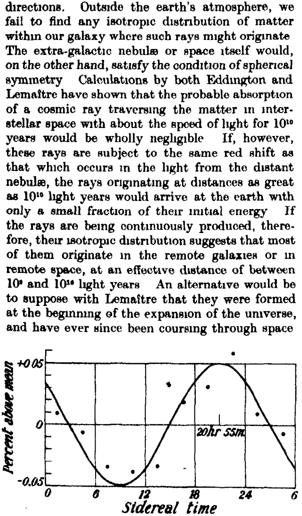

FIG. 2. Apparent effect due to rotation of galaxy Curve, theory; data,[6] complete year's observations by Hess and Steinmaurer

Some positive support for this view of the remote origin of cosmic rays is given by the fact that there appears to be an effect on their intensity due to the rotation of the galaxy[6]. According to Stromberg and Hubble, this rotation carries us toward declination 47° N. and right ascension 20 hr. 55 min., at a speed of about 300 km. per second—one thousandth the speed of light. If the source of the cosmic rays is outside our galaxy and at rest relative to its centre of gravity, calculation shows that at our latitude this motion should cause a diurnal variation, following sidereal time, through a range of the order of 0 1 per cent The best available records of cosmic ray intensity[6] show, as in Fig 2, a variation with sidereal time of about the predicted magnitude, and with its maximum at precisely the predicted time Though further experiments are necessary before other possible interpretations of this sidereal time variation are ruled out, the complete agreement with the predictions may justify the presumption that it is really due to the rotation of the galaxy This would necessarily imply that an important part of the rays originates outside the galaxy, a long-wanted justification of their rather heuristic appellation of 'cosmic'

HOW ARE THE RAYS PRODUCED ?

Of the many hypotheses regarding the origin of cosmic rays, none has received sufficient experimental support to gain general acceptance Those which assume the primary cosmic rays to be photons appear to be in definite conflict with the observed latitude effect Also those which would ascribe their origin to transformations of atomic nuclei with resulting loss of mass are unable to account for the huge energies of from 10^9 to almost 10^{12} electron volts which the more recent studies[7] seem to require for the individual rays Local or interstellar electric fields have been suggested, but the maintenance of such fields in highly ionised stellar atmospheres seems an insurmountable difficulty There remain, however, a number of theories which cannot thus be excluded. Prominent among these are Lemaître's hypothesis of 'super-radioactive particles' emitted at the initial explosion of his expanding universe, Swann's theory of the acceleration of electrical particles by electromagnetic induction from the changing magnetic fields of 'sunspots' on giant stars, and Milne's view[8] that the particles owe their energy to the gravitational attraction of the universe At present we are unable to give these suggestions a definitive experimental test

ACTION OF COSMIC RAYS ON MATTER

One of the most fruitful lines of cosmic ray research has been the study of their effects on passing through matter. Especially valuable have been the experiments with Wilson chambers in strong magnetic fields, and the use of Geiger-Müller counting tubes These and other methods have shown that a complex mixture of secondary rays is excited by the primary cosmic particles In this complex mixture, Anderson made the remarkable discovery of positive electrons, or positrons, which have since been found to play an important rôle in the absorption of high energy photons.

A prominent feature of the secondary radiation associated with cosmic rays is the occurrence of 'showers' of two to twenty or more high-speed particles emanating apparently from the same point These particles are about equally divided between positive and negative electrons. Furthermore, these showers themselves frequently occur in groups, all excited by some 'shower producing radiation'. This 'shower producing radiation', according to studies by Rossi, Blackett, Anderson and others, seems to consist of photons, similar to X-rays, produced at the collisions of the primary cosmic ray particles with atomic nuclei. Studies by Johnson[4] of the directional asymmetry of the shower producing radiation suggest that it is excited chiefly by the electron component of the primary cosmic rays, and that this component consists of about equal parts of positive and negative electrons.

Contrary to the situation for rays from radioactive materials, it would seem that, for these very high energies, photons may be more absorbable than electrons of the same energy, and that protons are probably the most penetrating of all The theories of Oppenheimer and Bethe and Heitler indicate that electrons are stopped chiefly by the excitation of photon radiation (X-rays). This results in an almost exponential type of absorption, similar to that of photons. These unanticipated results account in part for the confusion in our early attempts to identify the nature of the primary rays. The experimental study of these energy losses is beginning to give valuable results[9], while their adequate theoretical treatment seems to require a further extension of quantum-relativity electrodynamics. It seems probable that studies of these energy losses may supply our best means of testing those extensions of the present electrodynamics which are designed to account for the structure of electrons and nuclei.

Our analysis of the composition of cosmic rays is thus well under way, and from present indications should soon give conclusive results. The 'cosmic' origin of the rays, though perhaps not established, appears now more probable than ever How they originate is still obscure, but increased knowledge of their characteristics has helped to limit the types of hypotheses that are admissible Of immediate value is the use of these rays as a tool They have made possible the discovery of the positron, and now afford a means of extending our studies of the properties of matter to energies a thousandfold greater than are available from any other known source.

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[1] Detailed reviews of cosmic ray research, with comprehensive bibliographies, have recently been published by A. Corlin (*Annals of the University of Lund*, No 4; 1934) and E. Steinke (*Ergeb exakt. Naturwiss*, 13, 89, 1934) I shall here give references only to some of the very recent work not discussed by these authors

[2] A. H Compton and R J. Stephenson, *Phys Rev*, 45, 441; 1934.

[3] A. H Compton, *Proc. Phys. Soc London*, April 1935.

[4] Compare especially T H Johnson, *Phys. Rev.*, in press.

[5] A. H. Compton and I. A Getting, *Phys. Rev*, in press

[6] V. F Hess and R Steinmaurer, *Sitzber. Preuss. Ak Wiss.*, 15; 1933

[7] Compare, for example, A. H Compton, NATURE, 134, 1006, 1934 Similar estimates have previously been published by W Kolhörster and E Steinke

[8] E A Milne, NATURE, 135, 183, 1934

[9] For example, C D Anderson, Proceedings International Conference on Physics, 1934

Progress in Knowledge of the Upper Air

By DR. F J. W. WHIPPLE, Superintendent of the Kew Observatory, Richmond, Surrey

IN considering progress in knowledge of the upper air during the past twenty-five years, the first point to notice is that it is roughly true that in 1910 there was little more to be learned about the condition of the atmosphere below 20 km. and a great deal to be learned about the atmosphere above that level.

THE STRATOSPHERE

The most striking discovery that has ever been made in meteorology, the discovery that the familiar decrease of temperature with increasing height comes to a sudden stop at some 10 km. above sea-level, was already well established by 1910. The discovery was announced in 1899 by Teisserenc de Bort, who afterwards coined the names stratosphere for the isothermal layer and troposphere for the lower part of the atmosphere. A name for the transition, the tropopause, was introduced by Sir Napier Shaw comparatively recently. De Bort reported in 1902 that the tropopause was higher in anticyclones than in cyclones, the variation being from 12·5 km. to 10 km. In 1908 it was discovered by a German expedition to Victoria Nyanza that the tropopause was at a height of nearly 17 km. and that the temperature was about 190° A., much lower than the average temperature, 216° A., recorded in Europe.

It was soon realised that the explanation of the existence of the stratosphere must be based on the study of radiation. The permanent gases of the atmosphere are almost perfectly transparent to radiation both in the visible spectrum and in the part of the infra-red in which objects at atmospheric temperatures radiate. On the other hand, water vapour absorbs and radiates in this part of the infra-red. The theory put forward by Gold in 1909 depended on the investigation of the balance of radiation absorbed and given out by water vapour. The theory remains incomplete, for it is not clearly understood why there should be a sharp transition in the temperature gradient at the tropopause, and the contrast between the conditions over the equator and in higher latitudes has not been explained.

During the last twenty-five years, knowledge of the temperature distribution in the stratosphere has accumulated The meagre data from tropical regions have been supplemented by excellent series of observations in Batavia and in India, and in the far north the balloons sent up at Abisko in Lapland have yielded valuable information. It is now believed that over the tropics there is a considerable increase of temperature above the tropopause, the average temperature at 24 km. being about 220° A. On the other hand, near the Arctic Circle there is a wide annual range of temperature in the stratosphere. At 10 km. the range is from 212° A. in January to 227° A. in July. At 20 km. the averages in those months are estimated as 207° A. and 240° A.

The relations between pressure and temperature in the upper air were set out by W. H. Dines in 1911 in terms of correlation coefficients Dines was impressed by the strong correlation between the pressure at a height of 9 kilometres and the other variables, the height of the tropopause, the temperature of the stratosphere and the average temperature of the troposphere. It looked as if the movements of the atmosphere must be dominated by developments taking place at the boundary between the stratosphere and the troposphere. The doctrine was neatly expressed by Gold in 1914 in "The Ballad of the Stratosphere" .

> "I am the rolling Stratosphere,
>   I long to perturbate ;
> So I tickle the top of the Troposphere,
>   To make him undulate "

Later investigations have concentrated attention on the lower strata of the atmosphere, and nowadays most of the meteorologists who are interested in the day-to-day changes of weather are content to regard the stratosphere as playing a passive rôle. There is, however, a school in Germany which regards 'stratospheric steering' as dominating the movements of cyclones and anticyclones.

The theory of the stratosphere has been developed by Simpson, who has demonstrated that the heat balance of the atmosphere is maintained in such a way that the energy of such solar radiation as is not intercepted and reflected by the clouds eventually escapes as long-wave radiation. According to Simpson, any increase in solar radiation would be followed by an increase in evaporation from the oceans and an increase in cloudiness. This would reduce the fraction of the solar radiation available for heating the ground, the oceans and the atmosphere, so that the rise of temperature would be comparatively small It appears that the temperature of the stratosphere is governed by the properties of water vapour rather than by the strength of solar radiation. Simpson believes that the temperature would be changed but little if the earth received as much radiation as Venus or as little as Mars.

So early as 1875, Hann discussed the constitution of the atmosphere at great heights on the assumption that Dalton's law could be applied, each of the constituent gases behaving as if the others were not present. He showed, for example, that as oxygen is heavier than nitrogen the proportion of oxygen would fall off with increasing height. After the discovery of the stratosphere it was generally assumed that the same uniform temperature would prevail right through the atmosphere from the tropopause upwards, and that the density of each of the constituent gases could be calculated on that basis Whilst the proportion of hydrogen in air near the ground was only three parts in 100,000, this gas was found according to the calculations to predominate at 80 km and at greater heights. Wegener came to the conclusion that even hydrogen was not light enough to extend to the greatest heights at which aurora had been observed, and in 1911 he postulated a still lighter gas, geocoronium.

Faith in these calculations was rudely upset in 1922 when Lindemann and Dobson published their paper on "A Theory of Meteors and the Density and Temperatures of the Outer Atmosphere to which it Leads". Qualitatively there was little new in the theory of meteors In his "Thermodynamik der Atmosphäre", published in 1911, Wegener says that on account of the great velocity of a meteor the air does not get out of its way but is compressed The air is heated by compression, and heat from the air raises the superficial temperature of the meteor until it begins to evaporate. Wegener thought that the heated air would become visible, whilst Lindemann and Dobson insist that it is only when volatilisation begins that the meteor is seen That is a small detail, however: the important step was to calculate how much air must have been encountered before the meteor would be raised to incandescence, how much before it was completely volatilised and therefore disappeared. The result of these calculations was that the air throughout the range of height through which meteors had been observed must be much denser, at 100 km. a hundred times denser, than the speculations based on the hypothesis of uniform temperature had indicated.

The natural deduction was that the latter hypothesis was wrong The air at moderate heights must be sufficiently distended to support comparatively heavy air at the greater heights The case was met by postulating that the air at heights of 60 km and upwards was at a temperature of at least 300° A, about the average temperature prevailing on the ground It was pointed out afterwards that better agreement could be obtained by placing the base of this upper region of high temperature a good deal lower, at 40 km

THE TRANSMISSION OF SOUNDS TO GREAT DISTANCES

It was a curious coincidence that Lindemann and Dobson discovered the high temperature of the upper atmosphere in 1922. The observational material which they used in their calculations had been available for at least half a century. On the other hand, when they announced their discovery, investigations were in progress which were leading to the same conclusion. That the sounds of explosions could sometimes be heard at very great distances though inaudible at smaller distances had been noticed long ago; there is a famous instance, recorded in the diaries of Pepys and Evelyn, of firing in the Straits of Dover being heard in London but not at Dover The first detailed investigation of the phenomenon was made by van den Borne after a dynamite explosion at Förde in Westphalia in 1904 Previously it had been supposed that abnormal audibility could be explained by the effect of wind, but van den Borne came to the conclusion that this explanation was not adequate, and put forward the hypothesis that the sound waves travelled through the atmosphere at a great height. In his calculations he utilised Hann's estimates of the amounts of different gases in the atmosphere According to these estimates hydrogen preponderated at heights exceeding 70 km. In an atmosphere of hydrogen the velocity of sound is about four times that in ordinary air. Van den Borne saw that waves passing from the lower atmosphere into an atmosphere which was mostly hydrogen would be refracted and would return to the ground. He reckoned that waves starting upwards in a direction inclined at 30° to the vertical would reach the ground about 116 km from the source after culminating at a height of 75 km.

The theory seemed to fit the observations, though there was a good deal of scepticism as to the possibility of waves being transmitted through such attenuated gas.

Wegener's account of the theory is followed by the remark that systematic investigations of these sound phenomena could probably be carried out at no great cost and were much to be desired. The Great War provided plenty of opportunities for qualitative observations and directed general attention to the subject, but as a test of theory observations of the time of transmission of sound were needed. After the War, experiments were inaugurated by the International Meteorological Organisation.

These experiments and others have demonstrated that van den Borne's theory cannot be valid, for the times taken by the sound of an explosion to reach various distances are much less than the times computed by that theory

When Lindemann and Dobson announced that the atmosphere at 60 km was probably at a high temperature, it was seen at once that this provided the explanation of the phenomenon of 'abnormal' audibility of sounds at great distances. The same explanation was in fact propounded by Wiechert shortly afterwards without any reference to the work of Lindemann and Dobson

The investigation of the waves from explosions has been carried on, mostly by the use of autographic records Records of the transmission of air waves to great distances were secured within the Arctic Circle in Lapland and in Novaya Zemlya during the Polar Year Observations which show that the outer zone of audibility is a universal phenomenon have been collected in other parts of the world

Accordingly it is probable that high temperatures occur in the upper atmosphere in all parts of the world and at about the same height. More definite information can only be obtained by multiplying observations under controlled conditions.

OZONE

The existence of ozone in the earth's atmosphere was revealed by a remarkable feature of the solar spectrum, the absence of ultra-violet rays of short wave-length The visible spectrum ends at about 0 4μ, and photographs obtained with the quartz spectroscope show that there is a narrow band of ultra-violet, but this is cut off at 0 29μ In 1881 Hartley discovered that ultra-violet light was absorbed by ozone, and attributed to this gas the limitation of the solar spectrum, but Wegener, writing in 1911, passed over this evidence and based his statement that the quantity of ozone in the atmosphere increased with height on chemical analysis. He added, however, the remarks that the ozone was obviously produced by the action of ultra-violet solar radiation on oxygen, and the greatest part of this radiation was already absorbed at great heights. Accordingly, the distribution of ozone in a way which was inconsistent with Dalton's law was comprehensible.

The first estimate of the quantity of ozone needed to produce the absorption observed in the solar spectrum was made by Fabry and Buisson, whose work was first published in 1913. They announced that the ozone was localised in the atmosphere at heights above the regions accessible to man. Their method was to compare the intensities of light in different parts of the Hartley band and at different elevations of the sun. In this way they were able to eliminate the effects of absorption by haze and of Rayleigh scattering. The quantity of ozone is very small; it is equivalent to a layer of the gas at normal pressure and temperature only 3 mm. thick. If the ozone is in a layer 10 km. deep at such a height that the average pressure is 1/20 of an atmosphere, then in that layer the number of oxygen atoms united in molecules of O_3 is only $1/(2 \times 10^4)$ of the number constituting O_2.

The variations in the quantity of ozone in the upper atmosphere have been studied by Dobson with the aid of several collaborators. The results are striking. The annual variation in Europe has a range of about 30 per cent, the maximum occurring in the spring, the minimum in the late autumn. Both the mean amount (about 2 mm.) and the annual range are least near the equator. Within the Arctic Circle the mean is about 3 mm. and the range is nearly 50 per cent of the mean. There is symmetry in the northern and southern hemispheres.

No regular diurnal variation has been detected, but the amount of ozone varies with changes of pressure in the lower atmosphere. There is more ozone above places where pressure is low, the maximum amount of ozone occurring a little to the west of the centre of a cyclone. The minimum amount is observed a little to the west of the centre of an anticyclone. These results are consistent with the hypothesis that the ozone is transported by currents from polar or equatorial regions, and indicate that the currents at the levels at which ozone is found are generally in the same direction as the currents nearer the ground.

The earlier estimates of the height of the ozone depended on measurements of the absorption of the ultra-violet light in the direct solar beam at different times of day and especially on measurements made when the sun was very low; but the investigators were never very confident about the estimates which they gave of about 50 km. for the centre of gravity of the ozone.

Recently a new and powerful method of dealing with the problem has been developed by Götz, Meetham and Dobson. This method depends on measurements of the intensity of the ultra-violet light from the sky in the zenith. The essential difference is that, whereas in the older method the height of the ozone is compared with the radius of the earth, in the newer the height is compared with the heights at which the density of the air has assigned values. It is now found that the centre of gravity of the ozone is on the average at a height of about 21 km. The published observations refer to Arosa in Switzerland and to Tromsø within the Arctic Circle in Norway, and the difference in height is insignificant. In both locations the ratio of the densities of ozone and air is greatest at 35 km. or 40 km. It should be noted, however, that the Tromsø observations were made only in summer.

That the ozone is mostly below a height of 30 km. has now been confirmed in a very direct way by Regener. A spectroscope was carried up by a sounding balloon to about that height, and the spectrum of the light reflected upwards from a horizontal white surface was photographed automatically at regular intervals. It was demonstrated that as the maximum height was approached the spectrum extended at the violet end, clear evidence that the balloon had passed beyond the greater part of the gas which absorbs the ultra-violet light.

A "theory of upper-atmospheric ozone" has been developed by Chapman. The theory is too difficult and elaborate to summarise here. It may be mentioned, however, that oxygen is dissociated by the absorption of ultra-violet light of very short wave-length, that ozone is formed by the combination of molecular and atomic oxygen and that the ozone is eventually dissociated by the absorption of the ultra-violet of the Hartley band. Most of the oxygen atoms derived from the dissociation of ozone combine again to form new ozone molecules, so that the ozone is in a sense more persistent than the individual molecules of ozone. One notable success of Chapman's theory is that he declared that the ratio of the densities of ozone and oxygen should pass through a maximum at a moderate height, so anticipating the results of observation.

The theory that high temperature was produced in the upper atmosphere by the absorption of ultra-violet light was sketched by Lindemann and Dobson in 1922 in their paper on meteors. The theory was elaborated by Gowan. In his analysis he used the earlier estimates of the height of the ozone, and was led to the conclusion that, under certain assumptions as to the distribution of ozone and of water vapour, the air at such a height as 50 km. could be maintained at a temperature of 300° A., whilst much higher temperatures were to be expected at greater heights. The results were not in accordance with those derived from observations of the transmission of air-waves, which put the base of the high-temperature region about 10 km. lower down. Gowan's work requires revision in the light of the recent determinations of the height of the ozone layer, but at present it seems unlikely that the absorption of ultra-violet light by ozone and by oxygen can provide enough energy at the right levels to maintain the high temperature postulated to explain the refraction of sound waves It may be that the hypothesis of high temperature will have to be abandoned in favour of the view that the lightness of the atmosphere is due to the dissociation of oxygen It may also be that some source of energy has yet to be discovered.

AURORA

Whilst information as to the condition of the atmosphere at heights from 30 km. to 50 km. can be obtained in indirect ways, there is no method of investigating conditions between 50 km. and 80 km , though something can be gleaned from the occasional observations of meteor trails, which indicate that there are strong currents in this region 80 km. is approximately the lower limit of the aurora borealis in southern Norway Farther north there are few rays which come below 90 km. The majority terminate between 95 km. and 115 km., maximum frequencies occurring at 101 km. and 106 km. The upper ends of the rays are rarely above 400 km. during the greater part of the night, but after sunset, aurora can be seen above the earth's shadow extending to a height of 800 km. Krogness has suggested that the radiation pressure of sunlight drives the air forward so that the earth has a tail like a comet's, and that the high aurora is formed by corpuscles from the sun encountering this tail.

The spectrum of the aurora has been closely studied ; the majority of the lines in the spectrum are attributed to nitrogen, but the brightest, in the green, could not be identified with any line obtained in the laboratory until 1925, when McLennan and Shrum found it in an electric discharge through a mixture of helium and oxygen and demonstrated that the line was produced by a transformation of monatomic oxygen.

No lines associated with helium or hydrogen are observed in the auroral spectrum, so that it appears that the atmosphere in the highest levels consists of nitrogen and oxygen. It may be that any helium or hydrogen which diffuses to great heights is driven off in the comet-like tail of the earth.

It has been recognised for a long while that the corpuscles which produce the aurora carry electric charges and are diverted to the neighbourhood of the earth's magnetic poles by the action of the earth's magnetic field. The theory was elaborated by Birkeland about 1901 and has been developed further by Størmer. The height to which the auroral corpuscles penetrate is also the height of the lower of the two levels at which the atmosphere is a good conductor of electricity. These two layers have been discovered in the study of the transmission of wireless waves ; the lower is usually called the Kennelly-Heaviside layer and is at a height of about 100 km., the upper, discovered by Appleton, is at 220 km.

Chapman maintains that the ionisation at 100 km. outside the auroral zone is due to the bombardment of the atmosphere by neutral particles from the sun. These have about the same energy as the charged particles and penetrate to the same depth. The uncharged particles come straight from the sun, and therefore the supply is cut off at night. This theory is, however, open to question ; for the observations made on the occasion of the eclipse of the sun visible in North America in 1932 appear to indicate that the ionising radiation travels with a velocity nearly equal to the velocity of light.

The upper ionised layer at 220 km. is probably the region in which the ultra-violet light of very short wave-length is trapped by oxygen in the atomic state.

The two ionised layers are of importance in theories of terrestrial magnetism. Chapman believes that the upper layer is the seat of the electric currents which affect magnetographs at our observatories and produce the variations of magnetic force in the course of the solar day, and that electric currents in the lower layer are responsible for the variations which are governed by the moon, the latter currents being associated with tidal movements of the atmosphere.

A layer which has not yet been identified is that from which the light of the night sky comes It has been demonstrated that this light is not much-reflected sunlight and that it is not scattered starlight. The light must be generated in the earth's atmosphere by some slow process like the recombination of atomic oxygen. That atomic oxygen plays a part in the process is shown by the predominance of the green auroral line in the spectrum of the night sky. That the process is slow is proved by the fact demonstrated by Lord Rayleigh, that the intensity of the light varies but little during the night. Rayleigh finds in fact that the maximum intensity occurs about midnight. The layer from which the light comes must be rich in atomic oxygen. Chapman has given reasons for saying that this layer is probably between the Heaviside and Appleton layers.

Whilst the growth of knowledge of the upper atmosphere during the past twenty-five years has been rapid, there are probably more unsolved problems in sight than there were at the beginning of the period. It is safe to forecast that there will be a great consolidation of knowledge in the next twenty-five years, and that at the end of that period there will be still more problems awaiting solution.

Weather Forecasting

By DR G. C. SIMPSON, C.B., C.B.E., F.R.S., Director of the Meteorological Office

THE most important advance in weather forecasting during the last twenty-five years owed its origin to the War; but unlike so many other war-time advances, it was not made in connexion with the prosecution of war.

Twenty-five years ago, the method of weather forecasting, developed and described by Abercromby twenty-five years earlier, had undergone very little change. Synoptic charts were prepared and isobars drawn to indicate the pressure distribution. Seven main types of isobars were recognised, and Abercromby had described in great detail what kind of weather is usually associated with each. To take one example · the most common and most important pressure distribution is the cyclonic depression, and Abercromby prepared a diagram showing the weather association with this type of pressure distribution. He drew two ovals, one inside the other, to indicate the typical shape of the isobars; a long arrow was drawn along the major axis to indicate the line of movement of the depression, and the space within the oval was filled with descriptions of the weather which occur in the different parts. In the front of the depression *Pale Moon and Watery Sun* are indicated; in the right fore quadrant, *Muggy and Gloomy* are entered; and near the centre *Dirty Sky* and *Driving Rain* are noted. The forecaster having found a depression on his chart and determined the direction in which it was moving, would issue his forecasts on the assumption that places over which the depression would pass would experience the weather scheduled by Abercromby.

Abercromby's descriptions of the weather associated with each type of isobar were well done, and a very useful percentage of correct forecasts could be made; but the method was, by its very nature, unsatisfactory, for only average conditions could be forecast, and one knew from bitter experience that very large variations from type were possible.

Meteorologists were well aware that better forecasts could not be made on such a system, and that it was necessary to learn more about the physics of the atmosphere, and to take the upper atmosphere into account. For a number of years a very active investigation of the upper atmosphere had been carried on and important results had been obtained: the stratosphere had been discovered and many interesting statistical relationships between the conditions at different heights had been computed, but none of them appeared to be of much use in practical forecasting, and in any event no method was then known by which information regarding upper air conditions could be obtained sufficiently rapidly to be of use in preparing a forecast for the next twenty-four hours

Napier Shaw and Lempfert had tackled the problem in another way. They had investigated what happens in a depression by following the path of the air, and so determining where it came from and where it went The result was a classical paper on the "Life History of Surface Air Currents", and Shaw in a subsequent paper came very near to making the discovery which ten years later was to have such a revolutionary effect; but all this work, in spite of its great theoretical value, had produced very little to help the forecaster, and when the War broke out, Abercromby's empirical method was still the basis of all weather forecasting.

In Norway, although far removed from the seat of War, it was practically impossible to carry on the State Meteorological Service during 1914–18 owing to the total cessation of meteorological information from the outside world Under the guidance of Prof V. Bjerknes, the meteorologists decided to try to compensate for the loss of the foreign observations by increasing the observation posts within their own country. Prof. Bjerknes himself was a mathematician and not a forecaster, but there were two young men, one his own son J. Bjerknes, and the other H. Solberg, who took charge of the practical work The number of telegraphic reporting stations in the southern part of the country was increased from eight to about ninety. The observing stations were so close together that it was almost possible to follow individual masses of air from one to another.

When, by the aid of this close network of stations, the stream lines of the air were plotted, it was sometimes found that a broad and well-marked stream of air would seem to come to a sudden end. A long line could be drawn on the chart marking where the stream of air came to an end, and it was then found that beyond this line there was a strip of country, two or three hundred kilometres wide, over which rain was falling through a current of colder air flowing in a different direction. Further investigation, including a study of the temperature on each side of the line, showed what was really happening In all such cases a stream of warm air had met a mass of cold air and been forced to ride over it, the cold air forming a wedge up which the warm air ascended When air is forced to ascend in the atmosphere in this way it is cooled and precipitation takes place, thus accounting for the rain beyond the line marking where the ascent began Frequently these broad bands of rain can be traced for thousands of kilometres across country.

On other occasions it was found that a broad stream of cold air would end as abruptly against a mass of warm air, but in this case the rain band would be much narrower than in the former case and would be situated before instead of beyond the line of junction. The explanation was simple In this case the moving air, being colder than the air against which it was impinging, could not ride over it, but must travel underneath In effect, a wedge of cold air pushed its way under a mass of warm air and lifted it upwards over itself The rain due to the ascending warm air fell through the wedge, and therefore appeared at the ground in front of the line of junction between the two air masses

It was war-time, so it was natural to liken the process to that of advancing armies and to call the lines of junction between the masses of the air which extended for so many miles across the country 'fronts' A front at which warm air advanced against cold air and was forced upwards was called a 'warm front', while one at which cold air pushed its way under warm air was called a 'cold front' There was nothing very revolutionary in the idea of one current of air overriding another without mixing, the two currents remaining separated at a surface where there was a discontinuity of temperature and air motion. Helmholtz had investigated the conditions in which such surfaces of discontinuity could exist, Margules had worked out the formula for calculating the equilibrium-inclination of such surfaces and Shaw and Lempfert had already recognised them on their synoptic charts. It was, however, the next step made by the Norwegians which was so important, for they showed that warm and cold fronts are an integral part of the formation and development of cyclonic depressions. A depression forms on a surface of discontinuity which, as the depression develops, becomes differentiated into a warm front and a cold front meeting at the centre; while the precipitation is chiefly associated with these fronts.

Thus at last a physical structure had been put into a depression, and Abercromby's distribution of weather had been brought into an ordered relationship with processes taking place in the upper atmosphere. From then on, the forecaster had a new tool called 'frontal analysis' with which to work He now searches his synoptic chart for fronts and surfaces of discontinuity, and when he finds them he knows what weather to expect When a front has once been located, the surface of discontinuity associated with it can be followed by characteristic cloud formation and rain bands for a very long time In this way the forecaster is able to foretell even minor changes of weather and to fix with considerable accuracy the time at which the changes will take place. This is of inestimable value in connexion with forecasting for aviation

Fronts and surfaces of discontinuity are due to the existence of different masses of air which are brought into contact, and it is now necessary to say a few words about 'air masses' Air which remains for any length of time in one locality takes up the temperature and humidity characteristic of that locality, thus the chief characteristic of the air in polar regions is low temperature, while that of air in tropical regions is high temperature When air from polar or tropical regions moves into mid-latitudes it does not immediately take up new characteristics, but it retains those of its place of origin for a relatively long time, and it is possible, especially when upper air observations are available, to determine the origin of the air over very large areas

The two main types of air masses are polar and tropical, but polar air may come from a sea area or from a continental area, and although in both cases the air will be cold it will have different characteristics of humidity and lapse rate. In this way 'maritime polar air' and 'continental polar air' have come to be recognised 'Mass analysis' is now an important branch of 'frontal analysis', and many different types of air masses are specified by different names. Each of these air masses has its own physical properties which are important from a weather point of view. Polar air is generally clear, with good visibility; maritime polar air is very unstable owing to the warming of its lower layers when passing over the relatively warm sea, and in it showers and squalls easily develop, tropical air is generally very stable, and showers do not occur in it, but it is the tendency of this air to override cold air which, aided by its high humidity, gives steady rain; the visibility is generally poor in tropical air. The forecaster has therefore come to examine more closely the air masses, first because of their intrinsic characteristics, and secondly because it is at the junction between air masses of different origin that surfaces of discontinuity occur.

It has already been mentioned that, at the outbreak of War, upper air observations were not available, and if they had been forecasters would not have known what to do with them The conditions are very different now; for aeroplanes have made it possible to get the information quickly, and our new knowledge of the part played by air masses and surfaces of discontinuity makes all information from the upper air of great importance Practically all countries now use aeroplanes for upper air observations as part of their forecasting services.

There can be no doubt that during the last twenty-five years the forecaster has made great steps forward and forecasting is slowly being changed from an art, in which experience and intuition played the predominating part, into a science in which cause and effect are recognised and taken into account

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Conceptions of Man's Ancestry

By SIR ARTHUR KEITH, F.R.S., lately Hunterian Professor of the Royal College of Surgeons

WHEN King George came to the throne, anthropologists had begun to realise that man's family tree was to prove a much more complicated thing than was anticipated The discoveries made in France between 1907 and 1909 compelled them to abandon the idea that mankind had been evolved by a single progressive series of stages which, beginning in an ape-like stage, ended in the races of modern humanity They had to give up the single-stemmed family tree and substitute for it one with rather a shrub-like outline Most of them regarded Neanderthal man as a stage in the evolution of modern man. The discoveries made in France, at the date just mentioned, proved that this could not be so, and that Neanderthal man, after occupying Europe for a large part of the pleistocene period, had been suddenly replaced by representatives of modern or neanthropic man Whether the neanthropic races, which replaced the Neanderthal inhabitants of Europe, came from Africa or from Asia still awaits determination Neanderthal man could not be fitted into any single-stemmed scheme, he represented the end twig of a dead branch. Since 1910, several more dead branches have been discovered and fitted into provisional reconstructions of man's family tree

At the beginning of this period another idea relating to the antiquity of modern man was being much discussed. Was it possible that human beings, exactly similar to modern Europeans in details of structure, could have been in existence in mid-pleistocene times, when the 100 ft terrace of the Thames was being laid down and the large Chelles hand-axes were being fashioned? There were many—including the writer—who answered this question in the affirmative The case we relied on was that of Galley Hill, near Gravesend, but discoveries of a similar kind had also been reported from France, from Italy and from North America. Galley Hill man lay under mid-pleistocene strata which were apparently unbroken. The discoveries which have been made during the past twenty-five years have not supported the Galley Hillites, the opposite has been the case Most anthropologists now hold that the human body is so unstable in its constitution—and always has been so unstable—that it cannot continue the same over a long period of time, but must change Hence we are all inclined now, in the case of Galley Hill and all discoveries of a similar kind, to reject the geological evidence rather than believe that the human body can exist for a long period of time—say, 50,000 years—and remain unchanged

Our knowledge of Neanderthal man has been greatly extended In 1911 Marcelin Boule published his classical monograph on the anatomy of La Chapelle man—perhaps the best known of Neanderthal specimens The earliest or oldest trace of the Neanderthal phylum is represented by the Heidelberg mandible, which was discovered in 1907 In spite of a prolonged search, this is still the sole trace we have of the ancestry of Neanderthal man in the earlier part of the pleistocene period Two discoveries, however, have revealed stages which fill up in some degree the interval between the early Heidelberg and late La Chapelle stages in the evolution of the Neanderthal type One of these was made in the travertine quarry at Ehringsdorf, near Weimar, in 1925; the other was made in a gravel pit, just outside Rome, in 1929 At Ehringsdorf and at Rome, the Neanderthal skulls were embedded in deposits formed during the long temperate interval which preceded the last glacial period The Ehringsdorf man was big-brained and had certain characters more reminiscent of modern (neanthropic) man than the later Neanderthal specimens. There are reasons for linking the discovery at Ehringsdorf with that made at Krapina, Croatia, in 1906 A discovery made in 1924 revealed the fossil remains of Neanderthal man in the Crimea, thus carrying the distribution of this extinct type almost into Asia

One very strange fact is that not a fossil bone of Neanderthal man has been found in England Traces of his body were found in Jersey by Dr R R Marett in 1911, and they have been found abundantly in France and in Belgium Yet the work-floors of Neanderthal man abound in the south-eastern parts of England Fossil remains of neanthropic man (*Homo sapiens*) have never been found in or under an intact stratum containing the stone implements of Neanderthal man—implements of the Mousterian culture This culture has always been found in association with Neanderthal man

The most remarkable and the most unexpected discovery of ancient man recorded in the period under review was made at Piltdown, Sussex, in the opening years of the King's reign Eager search over a long period had brought to light human remains in many parts of England, but always they were of the present-day type English anthropologists had come to believe that the first and only inhabitants of England were men of the modern type, when to the surprise of everyone the late Mr. Charles Dawson and Sir Arthur Smith Woodward produced Piltdown man—the most remarkable form of extinct humanity which has been discovered in any part of the world The criticism which this discovery has met with, ever since its first announcement, has in no wise detracted from its authenticity or its importance Piltdown revealed the fact that, at the beginning of the pleistocene period, England was the home of men who had in their structure a mixture of parts—most of them modern yet some strange, such as those of the forehead, and some ape-like, such as those of the lower jaw Indeed, the Piltdown lower jaw has been assigned by quite competent zoologists to an extinct kind of chimpanzee Sir Arthur Smith Woodward found small fragments of other individuals at Piltdown, but so far no other traces of this early type of man has been discovered in England or elsewhere in Europe It is usually held that Piltdown man (*Eoanthropus*) represents a form of humanity which died out early in the pleistocene period This, however, is a view which is not held so firmly now as it was formerly.

Another type of humanity in early England, authentic in all details relating to its discovery, came to light when foundations were dug for Lloyd's Buildings in the city of London in 1925. The London skull, which was found then, occurred under a stratum laid down in mid-pleistocene times. This places the ancient Londoner well within the period when the inhabitants of Europe were Neanderthalians Although the London skull is incomplete, yet there is enough of it to justify the exclusion of its owner from the Neanderthal category The London skull is essentially modern in character, but in the opinion of the writer it does show features which suggest a relationship to the Piltdown type Only further discovery can determine the significance of the London skull and its place in the evolutionary family tree

Although only a single specimen of the humanity which occupied England at the beginning of the pleistocene period has been discovered, yet there is abundant evidence that England was a home for evolving mankind as early as the pliocene period Just before 1910, Mr Reid Moir announced the existence of humanly worked implements in the sub-crag beds of East Anglia He has added to his evidence in every one of the twenty-five years which have elapsed since 1910, and now distinguishes at least three distinct stone cultures under the Red Crag of Suffolk

In 1925, students of fossil man had their attention directed to Palestine by a discovery made near Lake Galilee by Mr Turville Petre Deep in the floor of a cave, rich with stone implements of the Mousterian culture, he found part of a skull, which although Neanderthal in its main characters, yet had certain features which were of a different nature Between 1929 and 1933, Miss Dorothy Garrod, working for the British School of Archæology in Jerusalem, explored the caves of Mount Carmel, and found them laden with human relics of the pleistocene period In one cave Miss Garrod explored and examined a continuous series of superimposed strata 52 ft in thickness—the most extensive and richest cave deposit known to us The strata covered the period in which Europe was inhabited by Neanderthal man Altogether, remains of about fifteen individuals were found in the Carmel caves, six of which represent approximately complete skeletons The fossil remains of ten individuals lay in the smallest of the Carmel caves which was excavated by Mr Theodore McCown All the fossil remains from the Mousterian deposits of Mount Carmel are of the Neanderthal type, but like the Galilean specimen, show many strange features in some of which they approach the modern type of mankind. Thus we now know that for a very considerable part of the pleistocene period—roughly its middle third—Palestine was inhabited by a strange breed of Neanderthal man, some of them very tall and massively built As in Europe, the Neanderthal race was suddenly replaced by men of the modern type at the end of the Mousterian phase of culture The present belief is that these ancient Palestinians represent an extinct people.

Almost at the same time as Palestine, China claimed, the attention of students of prehistoric man. By a series of isolated discoveries, it became known that the limestone hills at Chou-Kou-Tien, 37 miles from Peping, contained a vast cave packed with remains of the pleistocene period Most of the contents of the cave had been brought within the cave very early in the pleistocene period The oldest cave strata were found to contain crude stone implements, fossil remains of human beings and of hearths The fossil remains were found to represent a primitive form of humanity which Prof Davidson Black named *Sinanthropus*. *Sinanthropus* is certainly one of the oldest and lowest forms of humanity known to us His exact position in the family tree which represents the evolution of humanity is still uncertain Prof Davidson Black, who was cut off by death at forty-nine years of age in March 1934, was the man, above all others, who was best qualified to solve the enigmatic position of Peking man He died at Peping in the midst of his labours It may be that this ancient fossil type, so unlike any of the modern Mongolian peoples, may nevertheless prove to be on the line of Mongolian descent, for there are now grounds for believing that the chief races of mankind have been evolved in the continents they now inhabit

When the British Association met in Australia in the autumn of 1914, there was submitted to it a fossil human skull, known as the Talgai skull It had been derived from a pleistocene deposit in Queensland, and was marked by the cranial characters of the Australian aborigine, save that the jaws were more robust than is usual in the modern native and the brain was rather larger. The Talgai skull, which was described by Dr S A Smith in 1918, is the earliest representation of the Australian aborigine known to us

The publication of Dr S A Smith's monograph led Prof Eugène Dubois of Leyden to divulge a secret he had kept ever since 1891–92, when he was in Java and discovered the fossil remains of *Pithecanthropus erectus* He revealed the fact that he not only found these famous fossils, which came from very early pleistocene deposits—if not late pliocene—but also in deposits of late pleistocene date, two other fossil skulls These two specimens, known as the Wadjak skulls, like that of Talgai, had large jaws and also a great brain space Prof Dubois recognised that the Wadjak skulls had Australian affinities At first there was no suspicion of a direct relationship between the small-brained and lowly-placed *Pithecanthropus* and the large-brained Wadjak man. A discovery made by officers of the Geological Survey of Java makes it possible to believe that *Pithecanthropus* may be the ancestor of the Wadjak man, for the Solo skull, discovered in 1932, is intermediate to the other two skulls in many respects. It is intermediate in time and it is also intermediate in brain development We cannot assert as yet that the Australian aborigines have been evolved from a pithecanthropoid ancestor, but with the Solo, Wadjak and Talgai discoveries providing a series of rising evolutionary steps, we have now to consider seriously the possibility of such an origin for the Australian aborigine We have also to face the possibility of a separate or parallel evolution of various races of modern humanity Modern races may have come by their neanthropic characters independently of one another

In recent years, Africa has been providing evidence which raises a similar suspicion regarding the evolution of African races In 1913 there were discovered at Boskop, in the Transvaal, fossil remains of a big-brained specimen of humanity At first there was no evidence of its exact date, but now there are grounds for attributing it to a late phase of the pleistocene period The Boskop type, with a strikingly large brain and relatively small jaws, proved to be the forerunner of the Strandloopers of South Africa The Bushman type was also an inhabitant of South Africa in the later part of the pleistocene period as was proved in 1927 by the discovery of an ancestral form made by the Messrs Peers in the Fish Hoek Cave, in the Cape Peninsula The modern Bushman has not the size of brain or strength of jaw of his fossil ancestor The Boskop and Bushman are cousin types, and we may hope to find their common ancestor

Thus in later pleistocene times, Africa south of the Zambezi was the home of nearly related races, big in brain but short in stature At a much earlier period—perhaps as far back as the pliocene period, this part of Africa was the home of a remarkable anthropoid ape—one which made a nearer approach to man than either the chimpanzee or gorilla The existence of this remarkable ape—*Australopithecus* it was named by Prof Raymond Dart—was made known by the discovery in 1924 of a fossilised skull of a young individual in a limestone quarry at Taungs in the Harts River Valley some eighty miles from Kimberley The varying opinions formed by experts as to the significance of the Taungs discovery will be found in the columns of NATURE from 1925 onwards Indeed every discovery of ancient man made in recent years has found a full record in these pages

When we move to Africa north of the Zambezi, we enter another territory of human evolution Deep in the mine at Broken Hill, Northern Rhodesia, a remarkable fossil type of man came to light in 1921 The fossil type thus discovered is one of the most primitive forms of humanity known to us In his structural composition, Rhodesian man displays everything that we expect in an early stage of the evolution of modern man (*Homo sapiens*). Unfortunately, there was nothing found with the bones of Rhodesian man which tells us at what point in the pleistocene period he lived; we infer from the circumstances in which he was found that he is at least mid-pleistocene in date. Some light has been thrown on this and other problems relating to the history of early man in Africa by Dr. Louis Leakey's researches. Dr. Leakey led three expeditions to East Africa between 1925 and 1932, in the course of which he demonstrated the existence of implement-containing deposits covering the greater part of the pleistocene period. Near the base of these deposits was discovered a fragment of a human lower jaw—which has characters not unlike those we expect to find in Rhodesian man. In strata of later but of uncertain date at Kanjera, Dr. Leakey found cranial fragments of the most primitive type of Negro known to us. At first sight, the difference between the Rhodesian and Kanjera types of humanity seems very great, and yet in the opinion of the writer it is possible to conceive the evolution of the Kanjera Negro from Rhodesian man. Whether this evolution has taken place or not is one of the many problems which students of fossil man may hope to solve in the near future.

When King George came to the throne our knowledge of ancient man was almost entirely confined to Europe. Java was the only exception. Discoveries of fossil man of extinct types have now been made in every continent of the world. Every large land area—Europe, Asia, Africa and Australasia—has yielded fossil remains of human types totally different from any now living—all save America. No evidence has been found of the existence in the New World of a type of humanity that differs materially from types which still exist in America.

Discovery and Significance of Vitamins

By Sir Frederick Gowland Hopkins, P.R.S., Sir William Dunn Professor of Biochemistry,
University of Cambridge

Until the end of the first decade of the present century, official teaching concerning the nutritional needs of the human body was still based on the results of classical studies by Carl Voit and Max Rubner and on the views of the Munich School thence derived. The adequacy of a dietary was measured in terms of calories and protein alone. It was generally believed, alike by the academic physiologist and by those concerned with practical dietaries, that, questions of palatability and digestibility apart, so long as the food of an individual provided sufficient potential energy for the activities of his internal organs and for the external mechanical work he might be called upon to do, the only demand of a more specific kind made by his body was for a certain, rather ill-defined, minimum of protein, to subserve the growth and maintenance of its tissues. Beside the carbohydrates, fats and proteins which provide these essentials, natural foods were known, of course, to contain a variety of other substances. These, however, are present individually in very small amount, and except for certain minerals among them, necessary for the formation of bone and for the maintenance of particular physical conditions in the body, they assumed to be without nutritional importance.

Facts, nevertheless, were already known which might well have suggested that the body makes calls upon its food to supply needs more subtle and more specific than those thus recognised. The history of scurvy, for example, and the clear demonstration, made already in the eighteenth century, of the dramatic cure of that fell disease which follows upon suitable, though relatively very small, additions to an errant dietary, should, it would seem, have provided a strong suggestion for the existence in certain foods of a substance small in amount but with highly specific properties essential for the support of normal nutrition; that is, for the existence of what we now define as a vitamin. But unfortunately, the views of the majority concerning the influence of anti-scorbutic foods remained for many years vague and obscure. It was attributed to such qualities as 'freshness' without further analysis of these qualities, or to known constituents without proof of their efficacy. True, so far back as 1841, an American physician, G. Budd, had ascribed the action of such foods "to an essential element which it is hardly too sanguine to state will be discovered by organic chemistry or the experiments of physiologists in a not far distant future". Had organic chemists or physiologists been then stimulated by this objective view to seek for a definite substance in such well-known anti-scorbutic materials as, say, lemon or orange juice—a substance which when isolated could display by itself the anti-scorbutic powers of these fruits—it is likely that a realisation of the significance of vitamins might have come long ago, but current thought concerning nutrition was not yet prepared to profit from such suggestions.

Scurvy, of course, is now recognised as one of a group of so-called deficiency diseases—pathological conditions in each of which a group of symptoms is displayed, directly due to the lack of some necessary nutritional factor It was in 1897 that evidence for the existence of another such disease was clearly revealed. Eijkman, a Dutch hygienist, had been led by extensive observations to the belief that the disease beriberi was associated with the consumption by human communities of polished rice as a basal food He then found that it is possible to produce an illness in fowls similar to beriberi by feeding the birds on polished rice, and he was further able to prevent or cure it by administering an extract of rice polishings. The discovery that the disease could be thus produced and cured experimentally greatly assisted its study, just as the later observation of Holst and Frohlich that the guinea pig rapidly displays the symptoms of scurvy when placed upon scorbutic diets, while promptly cured by anti-scorbutics, made easy the experimental study of the latter disease and provided a ready biological test for the presence and relative amounts of the curative agent in various foods.

The explanation first offered by Eijkman for the production of beriberi during the consumption of polished rice was to the effect that the condition is a state of intoxication brought about by the consumption of excessive quantities of starch, and that in the so-called 'silver skin' which is removed by polishing, though not in the bulk of the grain, there is a substance which counteracts the toxic products of the disturbed metabolism. This hypothesis was far-fetched and inhibitory, but the conception of disease as the direct result of a specific deficiency in food was foreign to the thought of the time. Later, however, partly owing to the work of others and partly to extended experiments of his own, Eijkman came to the definite conclusion that there is present in rice polishings an individual substance differing from the then known food constituents, but essential to normal nutrition, though required in very small amount. Even before Eijkman himself had come to this final conclusion, the work of others had made it probable, and by 1910 the significant facts had become fully established. Among those whose work contributed to their establishment must be mentioned: Grijns, a countryman of Eijkman; Vedder and Chamberlain, of the American Medical Service; and the British investigators Fraser and Stanton, whose investigations were carried out in the Malay States. All of these helped to prove that the preventitive of beriberi is a definite chemical substance, and the last-mentioned in particular took pioneer steps which were ultimately to lead later workers to a successful isolation of that substance

Those who worked on beriberi during these years thought and wrote as pathologists, with their attention primarily directed to the causation and cure of a particular disease Though doubtless the suggestion for an extension of the kind of knowledge gained was ready to hand, as a matter of fact their writings at first contained no reference to the possibility that substances with the properties we now attribute to vitamins might function widely and prove to be necessary for the support of such fundamental physiological processes as growth itself

This more general and more physiological conception of the functions of vitamins arose directly from the results of feeding animals on experimental diets If the assumption were right that proteins, fats and carbohydrates, together with essential minerals, are the sole nutritional necessities, then these materials should support all the functions of the body when each of them is supplied in a pure form, no less adequately than when, in natural foods, they are consumed in association with small amounts of many other substances The nutritional value of such purified materials supplied in artificial dietaries was at one time the subject of many experiments The results of these were uncertain and contradictory, owing to the fact that purification was often not complete It was not then realised that substances present in extremely small amount may profoundly affect the value of a diet It is this circumstance that our present knowledge of vitamins has made so clear.

In 1906–7 the writer engaged in feeding rats upon highly purified materials of the above kind, and found them wholly unable to support health or normal growth, though certain additions, very minute in amount, greatly increased their nutritional adequacy. It happened that yeast extracts were among the addenda which were successful in this respect, but only, as is clear to-day, because the fat employed in these experiments was filtered butter fat We know now that butter itself contains certain of the essential vitamins, while yeast supplied the others. These experiments confirmed a personal belief in the importance for nutrition of minor constituents in natural foods, and public expression was given to this belief, but the experimental results were not then published.

In the autumn of 1911 the results of later experiments were communicated to the Biochemical Society, and these were published in the following year in a paper which made a general claim for the "importance of accessory factors in normal dietaries". Funk at about the same time impressively summarised the then available knowledge concerning deficiency diseases, and proposed the name 'vitamine' for the substance of which a lack might in each case be presumed to produce the pathological condition. On chemical grounds J. C. Drummond suggested that the final 'e' in Funk's proposed name should be omitted, and this has become customary. By 1912, then, there was fully adequate evidence for the wide importance of vitamins, and from that time progress in their study has been continuous.

Immediately before the War and until near its end, American investigators were the chief contributors to this progress. T. B. Osborne and L. B. Mendel at Yale and E. V. McCollum at Wisconsin (afterwards at Johns Hopkins University) were separately engaged upon nutritional experiments with artificial dietaries. For a little while after the present writer's publication in 1912, these workers were not fully convinced of the necessity for a vitamin supply. Osborne and Mendel believed for some time that they had succeeded in maintaining rats upon purified diets. Soon afterwards conviction came, and important contributions to the subject were made at both centres. In particular, American studies produced at this time proof that vitamins existed in natural foods in different associations, and led to a distinction between 'fat soluble' and 'water soluble' individuals, a distinction which, though in itself not of fundamental importance, greatly helped later developments in the subject, many of which have been due to workers in America.

During the later stages of the War, when many nutritional problems had to be faced, intensive studies began at the Lister Institute in London. These comprised pioneer work by A. Harden and S. S. Zilva, and the important experiments of Harriette Chick and her colleagues, which have continued to the present day. At this time, University College, London, became also a centre of activity owing to the work and influence of J. C. Drummond, while the classical experiments of E. Mellanby on the production of rickets were already in progress. A few years later, interest in the subject penetrated into every European country, and research became everywhere very active. Recently, publications dealing with vitamins have reached a total of a thousand in a single year.

To-day we have knowledge of some eight or nine vitamins, each proved to have its own specific influence in maintaining the normal course of events in the living body, and each exercising its functions when in exceedingly small concentrations. Happily the actual chemical constitution of some of them is now known.

It is, of course, impossible in a brief review to recount all the stages of discovery in the case of each of these substances. The existence of individual vitamins, each with its special influence in the body, has in the majority of cases been revealed by the experimental feeding of animals on the following general lines. Natural products or preparations—crude when experiments began—from natural sources, animal or vegetable, when simultaneously added in characteristically small amounts to a vitamin-free dietary, were found to render it capable of supporting normal nutrition. The tendency at first was to assume that each effective addendum contained one active ingredient. The next step in progress, however, involved the fractionation of each crude preparation, and this in many cases revealed the presence of more than one vitamin, with obviously distinct functions, each calling therefore for separate endeavours towards its isolation and purification. It may be mentioned in illustration that yeast, which because it represents a concentrated mass of living cells capable of active growth, and at the same time is available in large amounts, was early and justifiably looked to as a probable source of vitamins, has yielded some of them in a complex which even to-day has perhaps not been fully analysed.

The position of knowledge at the present moment will be made sufficiently clear if the most salient characteristics of each recognised vitamin are very briefly reviewed. Unfortunately, it is impossible at the same time to give credit to the many who have shared in the heavy labours involved in the remarkable recent advances in the subject.

Vitamin A. This vitamin is found in association with animal fats and exists in specially high concentration in the livers of fishes. It was discovered and studied in cod liver oil, and at first was not distinguished from vitamin D, but by 1922 it had become clear that there were two 'fat soluble' vitamins with functions entirely distinct.

Vitamin A exerts an important influence in the body. In its absence young animals fail to grow. Lack of a proper supply leads to degenerative changes in the epithelial cells which line the outer surfaces of the body, and among the characteristic symptoms which follow upon such a lack is a pathological condition of the eyes known as xerophthalmia. As an independent phenomenon night blindness may occur. Very noteworthy is the evidence which shows that an adequate supply of this vitamin protects against certain types of infection. One of the most interesting advances in our knowledge of vitamins is the recent proof that vitamin A is closely related chemically to the carotenes, a group of yellow pigments widely distributed in plant tissues, and the further proof that carotenes, when they are consumed in green vegetables, are converted in the liver into the vitamin itself. These discoveries have thus shown that vegetable foods are an effective source of the vitamin, and they have also greatly helped in leading to our present knowledge of its actual chemical nature It has been obtained pure in the form of an oil, and chemical studies have revealed its essential molecular structure

Vitamin B_1 This is the vitamin of which a deficiency in the food supply leads as a final issue to the disease beriberi It exerts a general influence in the body, and would seem to be essential to the normal progress of carbohydrate metabolism, but a specialised aspect of its functions is the maintenance of a normal equilibrium in the nervous tissues It is widely distributed in natural foods, but in concentrations which vary greatly We have seen that the circumstance of its presence in the cortical parts of grains and absence from the endosperm led, through the work of Eijkman and his followers, to one of the earliest suggestions for the existence of vitamins It is relatively abundant in yeast, and this has been the material chiefly used as a source of it for experimental work. Much effort in Great Britain, in particular by R Peters, has been spent in the effort to obtain it in a pure state, an end which seems now to have been reached Its actual molecular structure is not yet known, but its empirical formula is probably $C_{12}H_{16}N_4OS$ Alone among the known vitamins it contains sulphur in its molecule

Vitamin B_2 When yeast extracts were first employed as addenda to deficient diets, their most notable effect, apart from the promotion of growth, seemed to be the prevention of nervous lesions. They were supposed to supply an 'antineuritic' vitamin alone This is now B_1 Further studies of such extracts showed, however, that they certainly contain at least one other vitamin more stable towards heat than B_1, and clearly showing quite different properties. In its absence serious skin lesions develop resembling in animals those seen in the human disease pellagra. There is now indeed little doubt that a prominent factor in the causation of this disease is a lack of this vitamin in the food. It has been labelled B_2. Quite recently, however, a further complication has come to light in this connexion. Preparations of 'B_2' as hitherto employed would seem to contain two active factors, one promoting growth without being concerned with skin conditions, and a second to which the 'anti-pellagra' influence is due The latter is now under intensive study, but its chemical nature is yet unknown The former, like vitamin A, is related, as shown by the researches of R Kuhn and P Karrer, to a group of naturally occurring pigments, but in this case to the flavines The vitamin is in fact identical with a flavine which is present in milk

Vitamin C While the prevention and curative influence of foods containing this, the antiscorbutic vitamin, has been so long known, it remained for quite recent research to establish its existence as a definite chemical substance, to produce it pure and to determine its exact chemical nature It is present in most fresh foods but often only in very small amounts It is present in greatest concentration in fruits and green vegetables, but in amounts varying greatly from species to species Cereal foods contain none It is characteristically less stable than the other known vitamins, being destroyed when foods are long kept, dried or heated, the influence of oxygen being a potent factor in its destruction This instability accounts for many chapters in the long history of scurvy and its incidence Much labour has been spent during recent years in determining quantitatively its distribution in foods and in endeavour to isolate it Success in the latter aim was reached by A Szent-Gyorgyi three years ago Its constitution has been fully worked out by W N Haworth and his colleagues, revealing the interesting fact that the physiologically potent substance is related to the simple carbohydrates, being a derivative of the hexose sugar gulose The vitamin is now to be known as ascorbic acid.

Vitamin D This, the anti-rachitic vitamin, is generally associated with vitamin A in animal fats, and with the latter, is present in exceptionally large amount in fish liver oils Studies in the etiology of rickets have proved that this disease can be prevented or cured, on one hand by an adequate supply of this vitamin in the food, and, on the other, by adequate exposure of the body to sunlight A satisfactory explanation of this remarkable relation arrived with the proof that ultra-violet irradiation converts an inactive precursor into the vitamin itself, and that the former is present in the tissues. During the year 1929, owing in particular to the work of Rosenheim and Webster, and that of Hess and Windaus, it was made clear that the substance which on irradiation is activated is ergosterol, which in small amounts is present in most living tissues. As it is therefore present in many natural foods, the anti-rachitic value of these is increased by exposure to rays of suitable wave-length A preparation of the vitamin made by the irradiation of ergosterol *in vitro* is known as 'calciferol'. Its potency is remarkable; one ten thousandth of a milligram a day added to a rickets-producing diet will in a rat entirely prevent the appearance of the disorder. In the case of a child the effective daily dose is a very small fraction of a grain. The rigorous proof that lack of a fat-soluble vitamin is responsible for the induction of rickets was furnished by the classical experiments of E. Mellanby begun twenty years ago More recently, the importance of vitamin D in the processes of normal dentition has been shown by May Mellanby.

Vitamin E In 1922 it was first shown by H M Evans and K S Bishop that a vitamin, distinct from others then known, is essential for successful reproduction. It has been termed the anti-sterility vitamin, but this term implies functions more specific than those which are actual Deprivation of vitamin A, for example, will ultimately lead to failure in reproduction. Nevertheless, the influence of vitamin E (now so-called) is exerted on specific lines In its absence, there is degeneration of the testes in the male and a failure of the placental functions in the female The richest sources of this vitamin so far discovered are certain green vegetables and wheat embryos It is, however, widely distributed in food-stuffs, and as it is active in very small amounts, the possibility of any lack of it can seldom arise Its constitution is unknown

These very brief descriptions of the known vitamins leave out, of course, a multiplicity of facts which have been discovered concerning each of them, and omit reference to the work of very many investigators They may serve, however, to indicate the lines on which vitamin research has hitherto progressed.

Characteristic of each vitamin is the very small amount in which it exercises its physiological functions, and the circumstance that all are present in very low concentrations in the materials from which they have to be separated has greatly added to the difficulties of their study. It will be admitted, however, that we have now a sound body of knowledge concerning them, establishing their nutritional importance and throwing no little light on their nature. Research in the field is now receiving much help on its constitutional side from modern physical methods, and on its biological side from increasing interest on the part of a large number of clinicians. Vitamin therapy is now joining hands with endocrine therapy, and the League of Nations Permanent Commission on Biological Standards has recognised its growing importance by accepting standards for measures of vitamin activity and defining units in terms of such standards.

Some at least of the conditions which are now grouped as deficiency diseases are of world-wide importance, and though the clear-cut symptoms which the experimentalist can observe in animals under strictly controlled conditions are often obscured by intercurrent infections or other complications in clinical cases, yet, once a food deficiency has been recognised as an essential link in the chain of causation, the method of cure becomes in every case as certain as it is logical. On the other hand, once the hygienist has become convinced that this or that disease is really due to faults in the diet of communities, its prevention, with or without administrative action, should be easy to secure. Although a defect in the supply of a vitamin, if serious and continued, may result in actual disease, it is, in Great Britain, more important to realise that a sub-optional supply of any essential food constituent cannot fail to induce sub-normal health which, especially when induced in childhood, may leave permanent disability

Apart from its own inherent importance, the revelation of the significance of vitamins can fairly be said to have directed closer attention to the nutritional importance of other minor constituents of natural foods. The specific needs of the body are proving to be numerous, and lack of materials called for in very small amounts are proving to be just as important to final issues in nutrition as are those required in much larger amounts This applies to the mineral as well as to the organic constituents of food, and ill-assorted diets may be deficient in the former no less than in the latter.

For the progress of scientific knowledge concerning these needs, each separate factor has called, and continues to call, for separate and intensive study ; but the demands of right nutrition need to be viewed as a whole We need to know what should be the ideal balance among the many essentials, and how best to secure that it shall be approached in the food supply of all classes of the community Short of this, we have to-day sufficient knowledge to be sure that malnutrition in its subtler aspects often accounts for disabilities which have hitherto been ascribed to constitutional defects or to other circumstances. With present knowledge, moreover, it should be easy, economic questions apart, to prevent such malnutrition everywhere. There is almost sufficiency in the statement that certain foods often held to be luxuries have to be recognised as necessities for all. Recognition of this bears upon all the problems of a national food supply , upon production, preservation, transport and distribution.

It is interesting to remember that the effective development of the recent knowledge concerning the more subtle aspects of nutrition has been almost co-terminous with the reign of King George.

Structure and Physiological Activity

By JOHN PRYDE, Lecturer in Physiological Chemistry, University College, Cardiff

A SURVEY of the road which the biochemist has trodden during the past twenty-five years reveals a plenitude of milestones whereby the rate and extent of his forward march may be judged. The year 1910 was within a short span of the birth of his science; only four years earlier, the *Biochemical Journal* had first seen the light of day. The records of this now twenty-nine-year-old journal bear witness to the immense expansion and deepening, during the past quarter of a century, of our knowledge of the laboratories of the living cell, and there are many similar records to be found in other countries. New light has come from all sides on the chemical processes of the organism in health and disease, in life and in death. Innumerable new substances and previously unknown phenomena have been discovered and added to the ever-increasing physicochemical complexities of living cells and tissues.

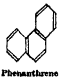
Yet despite this immense accumulation of detail, the answers to these persistent questions—"Just what happens in this particular living cell, and how does it happen?"—seem to elude us. Consider for a moment the contraction of a group of muscle cells, surely one of the most universal processes of animal activity. In 1907 appeared Fletcher and Hopkins's 62-page paper on "Lactic Acid in Amphibian Muscle", the first really effective attack on the problem of the possible rôle of this acid in the contractile process. At that time, lactic acid was the only known 'intermediate' substance supposed to play a part in the phenomenon. Now turn to the list of substances, many then unknown, revealed to-day as participating in this apparently simple process—hexose diphosphoric and monophosphoric acids, α-glycerophosphoric acid, phosphoglyceric acid, adenylic acid, phosphoric and pyrophosphoric acids, phosphagen or creatine phosphoric acid, pyruvic acid, methyl glyoxal, glyceraldehyde, dihydroxyacetone, and . . . but who of us is bold enough to write *finis* to this catalogue? In the numerous attempts to build up the chemical jig-saw here provided, many new and interesting and doubtless important facts have obviously been revealed, but we still seem to be almost as far as we were in 1907 from forming a really comprehensive picture of the sequence of events in a contracting muscle. Indeed one investigator has suggested that all the chemical transformations so far studied are really recovery processes, and do not directly participate in the contractile phase.

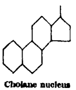
The present position of muscle chemistry will serve to illustrate one type of problem which the biochemist is studying in his attempt to provide an answer to the questions already mentioned. There are many similar problems. Most of them afford as much encouragement as the muscle problem to those who aspire to conquer fresh fields! There are also, however, problems of a rather different type which likewise concern the biochemist. A scrutiny of the records of the investigations here referred to conveys a greater sense of immediate achievement than that which is derived from a consideration of the muscle and similar problems. Here we have revealed to us the nature, and in many cases the detailed structure, of compounds of immense physiological potency, compounds some of which determine the issue between life and death, whilst others possess well-nigh incredible potentialities for the well-being, in some cases the ill-being, of living organisms. All seem to exercise their functions in the minutest traces, a fact which has added greatly to the difficulties of their isolation and identification, but during the last decade the progress achieved in this direction is highly impressive.

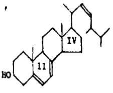
Most of the compounds now to be discussed may be assigned to one of two classes, hormones or vitamins—hormones if they are elaborated within the animal by specific tissues which derive their 'raw material' from the food supply, vitamins if they must be supplied pre-formed in the foodstuffs. This classification cannot be applied too rigidly, but it will serve. As we shall see, certain vitamins can be formed by the animal body, from precursors of very closely related chemical structure but devoid of the characteristic physiological properties of the vitamin. In the absence of the vitamin, such precursors assume the rôle of indispensable food constituents. To the chemist and the biochemist, the smallness of the amount of these substances which the animal requires is a matter of the greatest interest, but these investigators derive their main sense of achievement in this field from the ability to put down on paper the constitution or structure of the substances concerned. How the substances produce their specific effects is a secret so far guarded by Nature even more efficiently than that of the muscle. Nonetheless, science is for the present well content with having established the existence and structure of at least some of these enormously potent substances upon which animal life depends for its very existence

The constitutions of the known hormones or vitamins do not afford, in the absence of empirical information from other sources, *a priori* grounds for deducing their physiological activities, or for differentiating between an active compound and some closely related inactive compound with a structure but slightly different from that of the active one Such *a priori* deductions would necessitate much more fundamental correlations between structure and physiological activity than are yet available But, in actual fact, empirical information is rapidly accumulating, and as it becomes co-ordinated it is found possible to make certain prognostications regarding structure and physiological activity, to suggest, for example, what type of structure is likely to possess a particular activity, and possibly how such activity may be modified when certain substituent groups are added to or taken away from the basic structure

These general considerations are well illustrated by a series of compounds, including both hormones and vitamins, which have in common as a structural basis the condensed benzene ring system which the organic chemist calls phenanthrene The reduced phenanthrene system plus a fourth five-membered carbon ring forms the cholane nucleus, this nucleus is found in the bile acids and in cholesterol and the other sterols One of these sterols, ergosterol, $C_{28}H_{44}O$, when subjected to the action of ultra-violet radiation, undergoes a sequence of transformations, and amongst the products formed under suitable conditions is calciferol, which is isomeric with the original ergosterol Calciferol, which has been isolated in a pure crystalline condition, is vitamin D, the anti-rachitic vitamin essential for adequate ossification and for the control of calcium metabolism in the animal organism The structure of ergosterol is not yet ascertained in all its details, but existing evidence is in accord with the formula shown in skeleton below


Phenanthrene

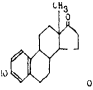

Cholane nucleus



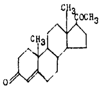
Suggested formula of ergosterol

It would appear that the transformation of ergosterol into calciferol involves the shift of the double bonds in ring II in the direction of the double bond in the side-chain of ring IV. But a final decision cannot yet be reached. The vitamin calciferol may be ingested as such by the animal On the other hand, it may be formed within the animal from previously ingested ergosterol This synthesis *in vivo* of the vitamin from its nearly related precursor has been proved experimentally to occur when ultra-violet radiation impinges on the skin The active rays have sufficient penetrative power to effect the transformation We have here the basis of the curative action in rickets of ultra-violet rays of solar or other origin

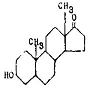
A structure of the cholane type is found in a series of recently discovered hormones possessing remarkably interesting properties. These are the sex hormones which determine the secondary sex characters of animals Three have been definitely characterised, the female follicular hormone or œstrone, the female corpus luteum hormone or luteosterone, and the male testicular hormone or androsterone All three show close structural relationships with each other and with the bile acids and cholesterol, amongst which their biological precursors are likely to be found The accepted structures of the three hormones are given below



Œstrone

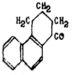


Luteosterone

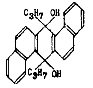


Androsterone

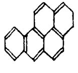
A development of exceptional interest in relation to structure and physiological activity is the preparation by synthetic means of artificial œstrogenic substances, that is, of substances not found naturally, but which possess an activity similar to that of œstrone One of these is 1-keto-1 . 2 · 3 4-tetrahydrophenanthrene, another is a derivative of the hydrocarbon 1 2 . 5 . 6-dibenzanthracene of which further mention will be made.



1-Keto-1.2 3 4-tetrahydrophenanthrene

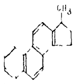


Derivative of 1.2 5·6-dibenzanthracene


1 2-Benzpyrene

The phenanthrene structure, common to all the substances so far considered, will be seen in the formulæ shown above. These two synthetic œstrogenic substances, it is of interest to note, do not show any androsterone activity.

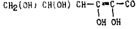
In the hydrocarbon 1 : 2 : 5 : 6-dibenzanthracene, we encounter one of the very interesting and, from human standards, very sinister synthetic carcinogenic hydrocarbons. This hydrocarbon produces, when applied to the skin of mice and rats, tumours which can be transplanted and are in all respects similar to malignant cancerous growths Yet the addition of two *n*-propyl and two hydroxyl groups converts it to an œstrogenic substance ! Dibenzanthracene is but one of a number of synthetic carcinogenic hydrocarbons All of these contain the phenanthrene nucleus Moreover, the long-recognised cancer-producing action of certain tars has now been traced to the presence of a hydrocarbon allied to dibenzanthracene and known as 1 2-benzpyrene It has been synthesised independently of its isolation from coal tar, and the powerful carcinogenic action of the pure substance has been amply confirmed It is, in fact, the most potent carcinogenic substance so far discovered It too will be seen to contain the phenanthrene nucleus



Diel's hydrocarbon, $C_{18}H_{16}$

Suggestive and interesting as is the rôle of the phenanthrene nucleus already outlined, three further references are required to complete the tale First, a series of toxic cardiac-stimulating glucosides is known These are derived from various plants including those of the species *Digitalis* (foxglove) and *Strophanthus* The aglucones (that is, the non-sugar parts) of digitoxin, strophanthin and several other closely related substances embody structures of four carbon rings which ally them closely to the sterols. For example, the dehydrogenation of the aglucone strophanthidin with selenium yields the well-known Diel's hydrocarbon, $C_{18}H_{16}$, of which the constitution has been established by synthesis. It has been prepared from several members of the cholane series, and its relationship to this series is beyond doubt. Many other structural details are known concerning the aglucones of the cardiac-stimulating glucosides and in some cases a complete structural formula can be suggested even now. Secondly, mention must be made of the toad poisons, amongst which is the Chinese drug Ch'an Su These contain structures closely allied to those of the cardiac aglucones, and possess a characteristic action on the heart similar to that of *Digitalis* preparations. Lastly, brief reference may be made to the significant fact that the phenanthrene nucleus is present in some of the most powerful alkaloids, in morphine and codeine of the opium group, in the corydalis alkaloids and in colchicine (meadow saffron).

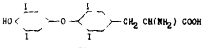
Let us leave now these inimical carcinogenic hydrocarbons, toxic glucosides, toad poisons and alkaloids and return to the kindlier theme of vitamins and hormones From the remainder of our story there stand out two achievements In both cases the proofs of the nature of the substances concerned—a vitamin in one case, a hormone in the other—have been clinched by syntheses Ascorbic acid, as the anti-scorbutic vitamin C is now termed, and thyroxine, the iodine-containing amino acid which confers upon the secretory protein of the thyroid gland its specific function as a regulator of the metabolic rate, have both been isolated in a pure state, and both have been synthesised As a justification for treating these two diverse substances together in this way, we may cite the exceptional brilliance of the work on the synthetic side The structures are shown below It will be seen that ascorbic



$$\mathrm{CH_2(OH)\ CH(OH)\ CH{-}\underset{\displaystyle OH}{C}{=}\underset{\displaystyle OH}{C}{-}CO}$$

Ascorbic acid

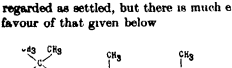
acid is a near relative of the carbohydrates—the starting material used in its laboratory synthesis



Thyroxine

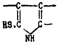
was a hexose, *d*-galactose, from which *l*-lyxose and *l*-lyxosone were obtained Thyroxine is related to the well-known amino acid tyrosine, and the latter is almost certainly the 'raw material' used in the animal body for its formation

The case of vitamin A, the growth-promoting vitamin, is especially interesting, since here we have another case of a vitamin which may be taken into the animal body as such, or in the form of a closely related precursor. The precursor is the remarkable, intensely coloured polyene hydrocarbon carotene, with no less than forty carbon atoms At least four isomeric carotenes occur in natural plant sources, and all appear to give rise to vitamin A in the animal body Approximately one half of the carotene molecule goes to form vitamin A, which almost certainly has the formula $C_{20}H_{30}O$. The structure of the vitamin cannot yet be regarded as settled, but there is much evidence in favour of that given below

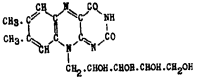


Probable formula of vitamin A

We may end our survey with a reference to advances which are being made in the elucidation of the structures of vitamins B_1 and B_2 Vitamin B_1 has the formula $C_{12}H_{18}O_2N_4S$. There appear to be two ring systems present; one a glyoxaline or pyrimidine, the other a pyrrole containing a substituent sulphur. Interest in vitamin B_2 has been greatly stimulated by the recent discovery that the flavins, which are yellow water-soluble dyes present in both animal and vegetable sources, possess intense vitamin B_2 activity The flavins are derivatives of alloxazine, and a substance stated to be identical with lactoflavin of milk whey has already been synthesised. It possesses the complex ring systems shown. So discovery marches onwards! Who shall say what additional structural formulæ will be recorded in a similar survey after the lapse of another quarter of a century?



One of ring systems of vitamin B_1



Lactoflavin

Diet and Disease

By PROF. STUART J COWELL, Professor of Dietetics, St Thomas's Hospital Medical School, London

THE twenty-five years of His Majesty's reign which are now being celebrated correspond remarkably closely with the establishment of a new era in the science of nutrition At the opening of the twentieth century, attention was being focused on the quantitative relations of the energy exchanges of the body and on the metabolism within the body of the proteins, fats and carbohydrates of the food. The physiologists and chemists working at these problems were making most valuable contributions to the body of knowledge concerning the processes of nutrition, but such contributions were for the most part not of such a nature as to afford obvious clues either to the origin of or to the treatment of disease The second decade of the twentieth century witnessed the rapid development of the view that the adequate nutrition of an animal depended on the presence in its food of hitherto unsuspected elements. The absence of such essential elements from a diet was proved to result regularly in the appearance of predictable signs of disease, and the fundamentally new idea of deficiency diseases became gradually established in current medical teaching.

Before mentioning any of the effects which this new conception of nutrition has had on the problems of the prevention and treatment of disease, it will be useful to hark back to the 'pre-Georgian' era to review the current teaching of the medical profession regarding the relation of diet to disease. The fact that faulty diets are often the direct or indirect cause of disease was of course fully recognised, as it had been for many centuries. But there was little precise knowledge available to enable definite diseases to be ascribed to specific dietetic errors. Over-eating was regarded as predisposing to many gastro-intestinal diseases, gout and raised blood pressure, and under-eating was considered to render the body more liable to invasion by harmful bacteria The idea of lack of balance between the various classes of foodstuffs, for example, relative excess or deficiency of protein, carbohydrate or fat was looked upon as at least an important contributory cause of disease. In the case of scurvy, it was already taught that the absence from the diet of some principle which was present in fresh foods but not in stale foods contributed largely to the production of the disorder. Otherwise the production of disease by faulty diet was largely related to the presence of toxins, pathogenic bacteria or living parasites in food which had become accidentally contaminated.

With regard to the practical dietetic management of diseases now known to be due to specific dietetic faults, the degree of divergence between the methods of twenty-five years ago and of the present day is distinctly less than would have been expected from a consideration of the knowledge available then and now. Specific remedies in medicine have again and again been discovered empirically, and this is true in the realm of dietetics. The treatment recommended twenty-five years ago by at least some enlightened authorities for many of the diseases now spoken of as deficiency diseases would prove satisfactory enough to-day, although such treatment was based on no actual knowledge of the dietetic factors involved. Scurvy was treated by giving fresh fruit and fresh vegetables, rickets and osteomalacia by giving cod liver oil and milk, beriberi by increasing the 'nitrogenous' constituents and diminishing the carbohydrate of the diet—some individuals were even claiming that it could be prevented by adding rice polishings to the diet of highly polished rice which was usually eaten in districts where this disease occurred—and finally pellagra was to be treated by cutting maize out of the diet.

This list of diseases comprises most of those commonly regarded to-day as vitamin deficiency diseases, and there are not lacking critics of modern nutritional research who profess to be unimpressed by its practical value in clinical medicine because many of its obvious applications had been forestalled by empirical methods of treatment. Such arguments fail to recognise the frequency with which valuable methods of treatment fall into disuse or are replaced at least temporarily by worthless imitations when little or nothing is known of the physiological action of the agents effective in alleviating the symptoms of disease Thus the value of fresh lemon juice in curing scurvy was known in the eighteenth century, but was forgotten for long periods, and far inferior therapeutic agents were sanctioned by high authorities as late as the present century. Similarly the value of cod liver oil for the cure of rickets had been appreciated for many years before the discovery of vitamins, but this did not prevent the subsequent recommendation of inert vegetable fats as satisfactory substitutes.

It is not argued that empirical treatment has no stable foundation in therapeutics, for clinical medicine still makes use of many old-established therapeutic measures which have as yet no scientific basis But it is no less certain that the scientific demonstration of a definite cause for a disease offers the best chance for the discovery of satisfactory preventive and curative treatment, and when the cause is proved to be a comparatively simple deficiency in the diet, there should be no excuse whatever for allowing such knowledge to sink into oblivion.

It is now proposed to show how the conception of food deficiencies as a cause of disease has developed during the past twenty-five years The great stimulus to the remarkable activity shown in this field of medical investigation during this period was undoubtedly the discovery of the vitamins, but the success rapidly attained by those engaged in studying the effects of vitamin deficiencies encouraged the investigation of the effects of other deficiencies, for example, deficiency in the mineral components of the diet, with the result that in such fields also many observations of the greatest importance have been made which have already proved invaluable alike in clinical and in veterinary medicine.

The period of nutritional research which we are surveying had already been heralded by isolated suggestions regarding the importance of dietetic factors other than proteins, fats, carbohydrates and minerals salts for the maintenance of health. Already in 1897, Eijkman had published his experiments on the production of beriberi, which led ultimately to the discovery of the antineuritic vitamin. Hopkins had stated in 1906 his conviction that scurvy, rickets and probably other states of ill-health were caused by unknown dietetic errors the nature of which was bound up with a defective supply of obscure food components. In 1907 Holst and Frölich paved the way for the identification of the antiscorbutic vitamin by producing experimental scurvy in guinea pigs But it was not until Hopkins had demonstrated in 1912 the fundamental importance of 'accessory factors' in the diet for securing normal nutrition that the idea of specific food deficiencies as a cause of disease began to gain any general acceptance

It is common knowledge that, since Hopkins's original announcement, the number of accessory food factors or vitamins generally recognised as being concerned in animal nutrition has been steadily increasing, though not all of them have been shown to be concerned in the production of human deficiency diseases By the end of the first decade of King George's reign, overwhelming evidence had been produced to show that beriberi was produced by deficiency of the water-soluble antineuritic vitamin, xerophthalmia by deficiency of a fat-soluble vitamin, rickets by deficiency of the same or a similar vitamin and scurvy by deficiency of the water-soluble antiscorbutic vitamin. It is not possible to trace in detail subsequent investigations, which have led on one hand to the chemical identification of many of the vitamins and on the other to some understanding of their physiological action It must suffice to point out how such knowledge has been applied to the prevention and treatment of disease

In countries such as Great Britain, frank vitamin-deficiency diseases, with the single exception of rickets, are uncommon, but there is increasing evidence that partial deficiencies of vitamins, particularly during the period of growth, are often responsible for sub-optimal physical development, inperfections in the structure of bodily organs and tissues, lowered resistance to certain infective diseases and many vague subjective and objective symptoms of ill-health It is almost certain, for example, that mild degrees of skeletal deformity caused by faulty feeding in childhood help to raise maternal mortality in childbirth by increasing the mechanical difficulties of labour. The low resistance of the teeth of large sections of our population to decay, with its many sequelæ of chronic disease and ill-health, is due in large part to faulty development of the teeth during the early years of life brought about by dietetic faults, of which vitamin D deficiency is the most prominent. Similarly it has been shown that, in dogs at least, the tendency to the development of pyorrhœa alveolaris in adult life is largely determined by the supply of vitamin A which was available during the period of growth These few illustrations must suffice to indicate that the original conception of vitamin-deficiency diseases has extended its boundaries to include a variety of diseases attributable to past dietary deficiencies, preventable by suitable feeding during the period of growth

Similar results have been achieved during the period under review by the study of specific mineral deficiency diseases Prominent among those mineral elements deficiency of which in the diet may lead to recognisable symptoms of disease are iron, copper, iodine, phosphorus, calcium and magnesium Lack of sufficient iron in the food has been shown to result frequently in the development of anæmia Such nutritional anæmia is particularly common in infants, and is accounted for by the fact that milk is a poor source of iron The recognition of this form of anæmia has proved to be of considerable practical importance, because it is often associated with an increased susceptibility to many of the common complaints of infancy and can be corrected with great ease The enormous amount of work that has lately been carried out on the relation between iodine deficiency and the development of goitre has not yet completely solved the problem of the causes of thyroid enlargement, but it has certainly provided very successful methods of wholesale prophylaxis in districts where goitre is endemic Lastly may be mentioned the revolution in the cattle-rearing industry of South Africa which has followed the discovery of phosphorus deficiency as the immediate or ultimate cause of serious losses in this branch of agriculture.

There can be no question that already the modern conception of nutrition has produced practical results of immense significance in both preventive and curative clinical and veterinary medicine The results are not confined to the prophylaxis and treatment of diseases which arise as the result of actual deficiencies in the food supplied They have already been extended to include the treatment of diseases in which defects in the absorption or utilisation of particular food elements rather than faulty diets are responsible for the development of co-existing signs of deficiency diseases The term 'secondary deficiency disease' is now being used to distinguish this particular class of nutritional disorder In this group might well be placed that once fatal malady pernicious anæmia, which the brilliant researches of the past decade have shown to be amenable to simple dietetic treatment, although there is no evidence that dietetic errors play any part in its causation As more and more precise information is gained concerning the intimate processes of metabolism within the body, there should be increasing opportunities of preventing and successfully treating disease by adjusting the diet to influence those metabolic processes which may produce the symptoms of disease when they deviate from their normal course This has long been one of the aims of clinical medicine, its ultimate realisation has surely been brought one stage nearer fulfilment by the nutritional investigations of the past twenty-five years

Viruses as the Cause of Disease

By Dr Joseph A Arkwright, F R S, Lister Institute of Preventive Medicine, London

At the end of the nineteenth century, a new category of infective agents was discovered which are now classed as viruses, in the modern sense of the word The chief property which unites them, and by which they have been distinguished from previously known minute parasites, is the extremely small size of their component particles, since these are smaller than bacteria, and many of them are not visible even with the highest powers of the microscope Until quite recently, it was customary to speak of all viruses as invisible, but in some cases the minute granules of which the virus appears to consist can be clearly seen, when stained, by direct microscopic observation; but in most cases they cannot be distinguished by their shape, but only by their uniformity, numbers and their source in special parts of the diseased tissues. The recent investigations by Barnard with the ultra-microscope and photomicrography by ultra-violet light have added to our knowledge of their size and form

A special feature by which the invasion of the cells of the host by many viruses can be recognised is the occurrence of 'cell inclusion bodies'. These forms, of which there may be one or more in a single cell, vary in size and may be larger than the nucleus. Opinion as to their nature has undergone various vicissitudes. After their discovery, when they were at first hailed as protozoal parasites, they were for long regarded as merely reaction products of the cell protoplasm to the presence of the virus, a position now favoured for the 'inclusion bodies' associated with virus diseases of plants. More recently it has been shown that in some virus diseases of animals these 'inclusion bodies' consist of masses of the minute filterable forms of 'elementary bodies' held together by a soluble matrix These bodies have been most completely and fruitfully studied in fowl-pox, small-pox, vaccinia, ectromelia—a disease of mice—and psittacosis, the infective disease of parakeets which also attacks man

The list of diseases of man and animals due to filterable viruses is continually being increased, and considerably more than fifty are now known, their study has been intensified and especially productive during the last fifteen years

The original recognition of the existence and importance of these agents was due to the use of earthenware and porcelain filters which retained the smallest bacteria When tissue extracts or secretions from an infected animal were passed through such filters, the filtrates were shown to be infective and capable of reproducing the disease in a fresh animal, this process could be repeated indefinitely, proving that the active agent multiplied in the animal body and was not merely a chemical substance or toxin The virus of foot-and-mouth disease, the first shown to cause a disease of animals, was discovered in 1898 by Loeffler and Frosch It passes through finer filters than any other known virus, so that no question of visible particles has arisen, since massed granules or inclusion bodies have not been observed The most essential qualifying characteristic of a virus has ever since been its filterability.

Most viruses remain active after being dried over sulphuric acid, and some are more resistant to alcohol and certain other disinfectants than bacteria Many viruses are present in the tissue juices in high concentration, and such suspensions in liquids can still prove infective when diluted 1 in 10^5 or 1 in 10^6. The resemblance in many respects of a virus to an excessively minute bacterium has led to the belief in their similar nature which is now held by most pathologists It must be admitted, however, that part of the argument is based on analogy, since viruses cannot be subjected to the same tests as bacteria to prove that they are living agents causing disease

Besides the small size of the ultimate particles of a virus and the resulting absence of a recognisable differentiating morphology, there are certain other peculiarities distinguishing these two classes of agents. Bacteria, with few exceptions, can be propagated on sterilised artificial culture media, and can be obtained in pure culture by the method introduced by Koch of selecting single colonies grown on a solid sterile medium. By this means their infective and other activities can be examined without the risk of contamination with substances derived from the host. A virus, on the other hand, in most cases requires the presence of living cells of the host to enable it to multiply, and it often appears to grow only or chiefly inside the cells of the animal tissues. Artificial culture of a virus can, however, very often be maintained in pieces of animal tissue kept alive and growing apart from the body The virus of fowl-pox, vaccinia or vesicular stomatitis of the horse and of some other diseases can also be propagated in the living embryo in an incubated hen's egg.

The fact that tissues of a host are needed to enable viruses to multiply has led to the suggestion that the virus may not necessarily be alive but may only serve as a stimulus to the host cells, causing them to reproduce the virus, and that the particles seen in a suspension containing a virus and indeed the virus itself are really products of the host

This suspicion has been especially strong in the case of the infective transmissible sarcoma of fowls described by Rous, which can be reproduced by injecting a filtered cell-free extract of the diseased tissues into a normal fowl The resemblance of avian sarcoma to other virus diseases extends to the recognition by Ledingham and Gye, by the use of the high-speed centrifuge, of minute particles resembling those of other viruses The nature of these particles was moreover confirmed by their reaction (agglutination) with the blood serum of animals which had been injected with the sarcoma, in the same way that similar reactions have been demonstrated with the elementary bodies from other virus diseases

The resemblance in structure and behaviour of the sarcoma of fowls to the malignant growths of mammals gives rise to hesitation before admitting that it is caused by an extrinsic virus, since mammalian malignant tumours have never been found to yield an infective cell-free extract and have been usually regarded as due to intrinsic tissue changes, though both mammalian and avian sarcomata can be induced by external physical and chemical irritants, such as tar and certain other substances

If therefore an extrinsic virus is one of the essential causes of fowl sarcoma, it must already be present in every susceptible fowl The view that viruses which produce disease are not essentially invading parasites, but are produced by the host, is opposed by the regularity with which diverse viruses can be propagated in the same kind of animal, and by the fact that the same virus may infect several widely different species For example, there are three distinct types of foot-and-mouth disease virus which produce apparently identical symptoms in animals and can only be distinguished by the fact that any one does not protect an animal against infection with the other two; nevertheless, each virus maintains its identity whether propagated in the cow, pig, guinea pig, rat or hedgehog. It is difficult to see how this could happen if the virus were produced by each species of mammal from its own tissues.

Another filterable agent, in many respects resembling the virus of an animal disease, is the bacteriophage, which was independently discovered by Twort and d'Herelle. The effect of a drop of a suspension of bacteriophage added to a young liquid culture of susceptible bacteria is that the latter are dissolved and a large amount of fresh phage is produced. The bacterium-free filtrate of the liquid culture may often be diluted ten million times and still the same effect be produced by a drop as by the original suspension.

D'Herelle and many other bacteriologists believe that the phage is a living agent which infects young growing bacteria, multiplies in their interior, and is set free when the bacteria die and break up.

Phage, though destroyed at a temperature of 70°–75° C., as a rule survives at 60°–65° C., when the bacteria with which it is associated are killed; it also resists drying and is remarkably resistant to the action of alcohol, acetone and chloroform. D'Herelle considers that all strains of phage are really one, though different strains become adapted to different bacteria, but more probably many phages when first obtained are a mixture of distinct races, and most filtrates containing phage are in the first instance derived from sewage or fæces, containing a great variety of bacteria.

Some strains of bacteria harbour a phage although apparently insusceptible to its destructive action. The activity is only manifested when a filtrate is tested on another susceptible strain. Thus many bacterial cultures have been shown to produce phage, though the presence of phage is not apparent and may not even have been suspected. This phenomenon suggests the original production of the phage by an uninfected culture, but it may merely be another instance of an apparently normal organism 'carrying' a parasite; many parallel cases are known of animals and plants 'carrying' infective agents whilst themselves unaffected. De Jong showed that cultures of certain sporing bacilli which produce a phage may still be 'lysogenic' after being heated at 100° C. for five minutes, whereas the free phage is killed at 70° C. for five minutes. When the spores germinate the phage is again liberated. This experiment suggests that the phage is preserved by its inclusion in the resistant spore, and this evidence of its derivation from the germinating spore *de novo* is not conclusive.

The chief reason for doubting the living nature of some phages and certain viruses is the very small size of their filtrable particles, which makes it very doubtful whether they can have a complex composition resembling that of other living things.

Different strains of phage are very unequal in their filterability; some have relatively large particles with a diameter about half those of vaccinia, while others pass through very fine filters, like the virus of foot-and-mouth disease, for which the diameter is estimated at about one tenth of the coarser phages.

The uniform and carefully graded collodion membranes introduced by Elford, of which the average pore diameter can be calculated, enables much closer estimates to be made than formerly of the size of particles which just pass or are just withheld. The size of the particles of some viruses has also been calculated, especially by Bechhold, by their rate of deposition when centrifuged at 10,000–15,000 rev. per min.

It has been possible to purify virus particles by first filtering and then centrifuging at high speed, washing the deposit and again centrifuging, as has been shown by Ledingham.

By the new collodion ultra-filters the diameter of the particles of different viruses has been estimated to vary from 200 mμ to 150 mμ for vaccinia to about 8–10 mμ for foot-and-mouth disease (μ = mikron = 1 thousandth of a millimetre; mμ = one thousandth of a mikron). It is difficult to understand how with such dimensions they can have a composition of sufficient complexity to consist of living matter. For comparison, the smallest bacteria have a diameter of 1·0–0·5 μ and the egg-albumen molecule has been estimated at 4·34 mμ diameter.

Doerr, in a recent treatise, while granting that some viruses have been shown to be living, denies the possibility of life in those of the smaller dimensions. It so happens that the viruses of foot-and-mouth disease and louping-ill, which are among those with the smallest particles, exhibit all the typical essential characters of viruses both *in vitro* and in the animal body, though causing very different diseases and having very different 'life-histories'.

The exact and quantitative experiments with filters have been made possible by the high concentration in which certain viruses occur, and by opportunities for determining the presence of the virus in different dilutions by inoculation of susceptible small animals. The dilution of some fluids containing virus from the animal body can be carried to 1 in 10^8 or even higher when dealing with foot-and-mouth disease, vaccinia and some other diseases without depriving them of infectivity.

The quandary arising from the very active and apparently vital functions of virus particles in spite of their small size raises the question whether the accepted definitions of life are universally applicable or whether some intermediate state between what is called living and dead matter may not exist, as has been suggested by Boycott.

Of the functions usually postulated for a living organism, assimilation appears to be the most characteristic and indispensable It is reasonable to assume that the metabolism of an organism would be much simplified if it existed in a circulating medium which provided a constantly changing supply of materials resembling its own components, such as might be afforded for an obligatory parasite living inside the cells of its host. Such an existence would have very different requirements from a truly independent life

Virus diseases are transmitted from one animal to another by very varied means Some, like canine distemper and certain influenza-like diseases of man, by droplets in the breath, others like yellow and dengue fevers by the bites of insects, others like louping-ill of sheep by the bites of blood-sucking ticks or of mites, again, the bite of the mammalian host is the usual mode of infection with rabies, but for many others the method of transmission is still uncertain In these respects they do not differ from diseases due to bacteria

It is characteristic of many diseases that, although the initial infection is caused by a virus, many of the symptoms and complications are due to secondary infections with bacteria, and this is notably the case in the influenza-like group in man, in swine fever, canine distemper and swine influenza

A virus may become remarkably adapted and sometimes permanently attenuated, when transferred to a new host, as is well instanced in the change of the virus of small-pox to vaccinia in cattle and rabbits, and of the rabies virus in the rabbit

The period of resistance shown by the host following an attack of disease is sometimes very prolonged, even lifelong, after small-pox, varicella, yellow fever and canine distemper, but in some other cases the protection afforded is of comparatively short duration, in foot-and-mouth disease usually for one to two years, whereas frequently recurring attacks due to the virus of *Herpes labialis* are common

This immunity is to a great extent due to the production in the animal body of 'antibodies' which can be found in the blood serum of recovered animals, just as occurs after bacterial infection. These antibodies can often be demonstrated by the formation of a precipitate or by the agglutination of the virus particles when a suspension of the elementary bodies is mixed with the serum, or by the neutralisation of the virus by the serum when both are injected into an animal These phenomena are of the same kind as the precipitation occurring when the blood serum of an animal which has been inoculated with a foreign protein (antigen) is mixed with the same protein *in vitro*, and are not peculiar to true infections

It is not intended here to do more than refer to the enormous and increasing number of filterable viruses known to cause infective disease in plants and found in their juices These, like mosaic disease of tobacco, spotted wilt of tomato, and crinkle and leaf-roll of potato, may cause very serious disease, or in other cases may be present throughout the plant without producing any visible effect, as in some infections of the potato

There is good evidence that two viruses may co-exist in the same plant, and as a result the symptoms may be either much more or much less severe than when either virus is present alone

Some viruses are transmitted by insects such as aphis or thrips, while others pass by unknown means In some of these diseases of plants peculiar 'inclusion bodies' are found in certain cells, but their relation to the virus is undetermined It is known that these 'bodies', as well as some of the symptoms due to a virus, can in special cases be imitated by the addition of certain inorganic salts to the soil, but the disease is not then transmissible. Some plant viruses are highly resistant to drying, chemical action and alcohol, and in many ways the viruses of plants resemble those of animals.

The problems which the behaviour and properties of viruses raise are of great practical and theoretical interest, and are by no means yet solved

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Heat Production of Muscle and Nerve

By PROF. A. V HILL, O.B.E, F.R.S., Foulerton Research Professor of the Royal Society

THE first paper by the present writer on this subject was printed almost exactly twenty-five years ago in the *Journal of Physiology*: the coincidence reinforced the invitation of the Editor of NATURE to write an interim report.

The heat production of muscle had been investigated in the past by such scientific giants as Helmholtz, Heidenhain, Fick and Blix: and indeed it was with Blix's apparatus, purchased by the providence of Langley and set in order by the Cambridge Instrument Company in the days of Horace Darwin and Keith Lucas, that the present experiments began. For some time, apart from Blix's work on the relation between heat production and muscle length, little of importance had been done on the subject; but, as Langley wrote in a letter dated November 11, 1909, "an especial problem" had been "suggested by Fletcher and Hopkins's work on the efficiency of the muscle working with and without oxygen. . . . Once started, there are plenty of further experiments to do". The indication was clear: and in 1912 it was shown that a considerable part of the heat set free by an active muscle "occurs in recovery processes—presumably in the oxidative removal of the lactic acid liberated during contraction". The recovery heat production of muscle has been a fruitful subject of investigation in the intervening years; the most recent papers have pushed its analysis to the extreme case of a single twitch in which, in a muscle of about 0·1 gm., 0.0002 calorie is liberated in the fifteen minutes following contraction.

The 'initial' heat production—that which occurs during actual contraction—has been extensively explored. Its investigation has led to great improvements in technique, for not only its amount but also its distribution in time relative to the various phases of mechanical activity had to be determined. The former demanded calibration of the thermo-electric apparatus, together with the muscle, in absolute units of heat: the latter, great rapidity in recording. The heat had to be related to the force developed and maintained, to the work done, to the character, the duration and the frequency of the stimulus, to the temperature and to the physico-chemical condition of the muscle. It was shown quite early (1914) that the initial heat, and its relation to force developed, are independent of the presence of oxygen; so that the chemical processes of contraction were presumably of a non-oxidative character. This fact has a fundamental bearing on the nature of muscular fatigue of the rapid 'athletic' type: as also has the behaviour of the delayed oxidative heat production on recovery from such fatigue: but that is another story.

In 1912 the first attempt was made to relate the heat associated with the process of muscular activity to the only chemical events then known to occur: the formation and subsequent removal of lactic acid and the production of carbon dioxide. It was clear at once, as has been abundantly verified since, that the lactic acid was not removed simply by oxidation—the heat was far too small. In 1913, Peters published the first direct comparison of the initial heat with the lactic acid set free, and from 1919 onwards Meyerhof and his colleagues have made full use of the relation between heat and chemical change in their exploration of the intermediate mechanism of contraction. Lactic acid is no longer the only chemical substance known to be liberated in activity: creatine-phosphoric acid breaks down, and a complex sequence of phosphate changes has been discovered. It is probable indeed that the primary energy change in muscular activity is not lactic acid formation at all, and that the latter process is really the first stage in restoration, a non-oxidative stage rather rapidly completed, and followed (if oxygen be present) by the oxidative processes of recovery referred to previously. Here again the heat has thrown light on the problem, since, even in the complete absence of oxygen, a significant amount of heat is set free in the first minutes following muscular activity.

From the general scientific point of view, apart from the details of chemical machinery, the following broad conclusions may be drawn:

(i) The muscle is not a heat engine, but a chemical engine working at practically constant temperature.

(ii) It possesses an 'accumulator' mechanism by which energy can be liberated very rapidly without oxidation, and a 'recharging mechanism' by which the *status quo* can be restored under the influence of, and at the expense of energy derived from, oxidation.

(iii) It is primarily a machine for developing and maintaining force, not for doing work: even if no work is done, the muscle contracting at constant length, even if negative work is done as when a muscle is stretched during contraction (for example, in walking downstairs), considerable heat is liberated, more the greater the duration of contraction. It is true, as Fenn (1923) found, that there are significant relations between work and heat, but these do not disguise the fact that the primary relation between thermal and mechanical effects is one between heat and force developed and maintained.

(iv) The 'efficiency' of the muscle machine, considering the whole cycle of breakdown and recovery, that is (work done)/(total energy set free) could never be greater than about 50 per cent, since the recovery process frees about as much energy as the initial process, and the latter always shows a positive balance of heat, even when maximal work is done. Under actual working conditions in man the maximum 'efficiency' is about 25 per cent. The energy is derived ultimately from the oxidation of foodstuffs.

(v) Little is yet known of the means by which 'excitation' induces chemical change and the latter mechanical effects. The existence (in some muscles) of optical phenomena running parallel with the thermal and mechanical changes, and the alterations of apparent viscosity during contraction, strongly suggest that the ultimate cause of the mechanical effects is a reversible rearrangement in a system of large protein molecules, on which X-ray analysis, or the methods of surface chemistry, may ultimately throw light.

A not unimportant result of work on the heat production of muscle has been the enforced improvement of galvanometers and of thermopiles of the insulated type. This has had some interesting by-products; for example, (i) a sensitive method for measuring the slow resting heat production of a small object; (ii) a method of determining the vapour pressure depression of a small quantity of solution (down to 0.1 mgm.) to an accuracy considerably better than 1 per cent.; (iii) the possibility of further progress in studying stresses in engineering structures by means of their thermo-elastic properties; (iv) a method of increasing galvanometer sensitivity by the use of a photo-cell.

Most important, however, from the point of view of physiology, has been the work on the heat production of nerve. It was formerly believed that a nerve transmitted its messages without loss of energy, that the nerve impulse was in some sense analogous to a mechanical or electromagnetic wave in which all the energy involved is put into the system at the start. Unsuccessful attempts to measure the heat production of stimulated nerve supported this point of view. As a matter of fact, it is quite wrong: the heat is very small, but it is measurable and it obeys certain quite definite rules. In the transmission of a single impulse in medullated nerve, there is an 'initial' production of heat of 2×10^{-6} to 8×10^{-6} calorie per gram of nerve, and a recovery heat production of ten to thirty times that amount. The time-course of the latter, occupying 10–30 minutes (at 20° C.), has been mapped out; the relation of the former to temperature, frequency of excitation and other factors has been determined.

The results have been confirmed by measurements of the oxygen consumption, and attempts have been made to determine the chemical changes underlying the transmission of the nervous impulse. These latter have not, as yet, had much success, owing to the extreme smallness of the quantities involved. It is probable that the first stage in nerve transmission is the building up at each point of a critical electrical potential, under the influence of the electric accompaniment of the impulse approaching from a distance. When the potential reaches its critical value at any point a state of instability of unknown nature results, the insulating properties of the nerve boundary change, and the potential difference normally existing at that boundary is now able to produce a current to neighbouring regions: these in turn are similarly activated and the wave is propagated. The nerve boundary then returns to its normal insulating state. The initial heat is presumably due to the chemical events associated with this cycle of membrane changes, as in muscle where, with 100,000 times as much heat, chemical changes are associated with contraction and relaxation. The recovery heat may be due either to an oxidative reversal of these chemical changes, or to the restoration of the ionic differences responsible for the resting potential difference across the nerve boundary.

For the moment, there is a lull in these measurements of heat in muscle and nerve; further progress is probably to be sought chiefly in other directions. Micro-chemical methods need to be greatly improved if the chemistry of nerve activity is to be understood; the physical chemistry of the active boundaries involved in nerve transmission requires an application of the new technique of surface chemistry; the electrical accompaniments of excitation and transmission need more accurate quantitative study. On the muscle side, owing to the greater magnitudes involved, the chemistry is not so difficult, and considerable light is being thrown, and a very complex system is being revealed, by biochemical methods. The newer methods, however, of optical and X-ray analysis need to be more fully tried before one can say how far alteration in complex molecular systems will be found responsible for the mechanical accompaniments of activity. The effects of high hydrostatic pressure on the behaviour of muscle and nerve, and the changes of volume accompanying contraction, also may throw light on the mechanism.

These researches have been due to the co-operation of many. Langley started them on the suggestion of Fletcher and Hopkins's work. Burker and Paschen, in respect of thermopiles and galvanometers, gave fundamental help. R. A. Peters, Weizsäcker, Parnas and Lovatt Evans collaborated before 1914. Hartree for many years bore the brunt of the experiments (and the arithmetic!) on the analysis of muscle heat into its constituent phases. Downing similarly contributed his skill in the construction of delicate instruments. The work of Meyerhof, of Embden, of Parnas, of the Eggletons, of Lundsgaard and of many others brought light from the chemical side. Fenn's fundamental researches on the relation between work and heat have been, and Gerard's on the subject of nerve metabolism must be, recorded. Azuma, Ernst Fischer, Gasser, Parkinson, Cattell, Furusawa, Wyman, Bronk, Bozler, Feng, Levin, Cowan, Bugnard, Rosenberg, each furnished a characteristic contribution. The list is not exhaustive. In spite of the present lull, at any stage in further progress reference may have to be made once more to the so-called 'myothermic' and 'neurothermic' methods, which have so great an advantage in their quickness and sensitivity, and in the fact that they can determine so fundamental a quantity as the total energy without any injury to the experimental object. The usefulness of these methods will probably not end with the jubilee of their revival.

Therapeutic and other Applications of X-Rays and Gamma-Rays

By Dr. G. W. C. Kaye, O.B.E., National Physical Laboratory

WITHIN a period of fifteen years prior to the King's accession, Rontgen had discovered the X-rays and J. J. Thomson the electron, Becquerel had discovered radioactivity and the Curies had isolated radium. The new reign was to prove an era of X-ray and radium research no less fruitful than its predecessor. In particular, the X-ray crystal diffraction experiments of Laue in Germany in 1912, followed by those of the Braggs in England, opened up a new vista of research which has left its mark on physics, found diverse and important applications in industry and is beginning to acquire significance in the biological sciences. Rontgen, who had lived to see many of these developments, died in 1923 in his seventy-eighth year, poor in fortune, but consoled by the beneficent services which his discovery had rendered in the War.

The British Army entered the War relying entirely for its X-rays on induction coils and 'gas' tubes, both well-nigh obsolete now. About 1908, Snook developed the high-tension closed-core transformer with rotary-arm rectifier, and in 1913, Coolidge introduced the hot-cathode X-ray tube. Much development has since followed. The X-ray tube of to-day is self-protected and shock-proof, and is even claimed to be climate-proof! The complete equipment is earth shielded, permits precise control and is silent in operation. The high-tension transformer works in conjunction with one or other of the rectifying-valve and condenser circuits, which deliver either pulsating or constant high voltage to the X-ray tube. In routine medical radiology, these voltages range from 60 kv. to 200 kv., but 400 kv. and up to 1,000 kv. are now to be found in certain therapeutic centres.

In 1910, X-ray diagnosis was fairly well advanced, but radiation therapy was in its infancy. Protection for the worker was rudimentary or non-existent, and many injuries and deaths resulted. Not until 1921 were the British protection recommendations issued by a representative committee, and these, the first in any country, were used as a basis for international agreement four years later at Stockholm. These recommendations, which are revised triennially by an International Protection Commission, have been adopted throughout practically the whole civilised world. They have not only provided effective safeguards against the working dangers of X-rays, but also have contributed, as no other factor has, to the better housing and general well-being of the X-ray and radium worker. Most radiology departments in 1910 were deplorably housed, whereas the light, roomy and well-ventilated departments of to-day are often a source of pride to hospitals.

Another vital step in the progress of radiation therapy was the adoption of the rontgen (r.) as the international unit of X-ray quantity or dose. The röntgen, which is an air-ionisation unit, was the subject of an international intercomparison in 1931 by the national laboratories of the United States, Germany and Great Britain, a very satisfactory measure of agreement resulting. It is probable that the röntgen will be adopted internationally for gamma radiation also, though further measurements on both gamma and high-voltage X-radiation are required.

Radiography has found considerable application in the industries and arts, for example, in the examination for flaws and other defects in metal castings and forgings, welds and assembled components. Wooden aeroplane parts were examined radiographically in the War. Many millions of clinical thermometers under test have been expeditiously scrutinised at the National Physical Laboratory by the use of X-rays during the last ten years. Other industrial applications include the screening of electrical insulators and golf balls during manufacture. The National Gallery and the Courtauld Institute have recently installed X-ray outfits for the examination of pictures and objects of art. Gamma-rays are resorted to in the radiography of metal specimens too thick for X-rays to tackle.

It is, however, in the world of medicine and surgery that X-rays and radium have been turned to account most outstandingly. X-ray diagnosis has improved in the last twenty-five years to an almost spectacular extent, and radiation therapy, though of more recent growth, has now established its claim to an important place in the treatment of malignant disease. The use of radium for cancer treatment was given impetus in Great

Britain by the formation in 1929 of the National Radium Trust and Commission, which were constituted to distribute and administer some quarter of a million pounds worth of radium which, it will be remembered, was subscribed for as a national thanksgiving for the King's recovery from his illness. The Trust and Commission were given powers by their Charter not only to augment existing supplies of radium for the treatment of the sick, but also to advance existing knowledge of the best methods of rendering such treatment

I would here mention that in what follows, I have had the advantage of the experienced and authoritative assistance of Dr Constance Wood, whose responsibility for the medical opinions expressed I gratefully acknowledge

While it is still the case that the whole of the gastro-intestinal tract and early carcinoma of the breast are best treated by surgery, X-ray and radium therapy is bidding fair to displace the knife in the treatment of certain other forms of cancer The response of tumours to radiation demands wide study, each type of tumour having a different response, both clinically and histologically Views on radiation treatment have changed and the single massive dose of X-radiation, formerly advocated at Erlangen, is now replaced by a sequence of smaller doses spread over a period of time

As to the quality of radiation required, this depends on circumstances In certain superficial forms of cancer, such as rodent ulcer, almost any type of radiation will produce healing, whether it be low-voltage X-rays (for which high-power close-proximity tubes are now available) or the beta- or gamma-rays of radium Other types of cancer, such as squamous epithelioma of the skin and lip, are successfully treated by a few milligrams of heavily screened radium, the residual scar frequently being quite invisible

The real problem of malignant disease lies, however, in the treatment of glandular metastases Small quantities of radium or low-voltage X-rays are not capable of destroying cancer cells at a depth ; for the deeper lesions and gland areas we turn either to (*a*) X-rays which, excited by very high and ever-increasing voltages, tend to approach gamma-rays in quality, or to (*b*) large quantities of radium placed at distances remote from the skin in an attempt to obtain the large depth doses possible with X-rays Both methods have their advocates. From a financial point of view, Regaud estimates that when the heavy initial cost and low maintenance costs of a large radium unit are balanced against the lower initial cost and higher running costs of a high-voltage X-ray plant, there is little to choose between them at the present price of radium, though the possibility of an induced radioactive element of sufficiently long life to make its use practicable may perhaps be envisaged. Adequate protective arrangements appear to be possible with either radium or high-voltage X-rays

The early progress of 'teleradium' was slow, and its ultimate value is a matter on which opinions differ, but the growing belief in its efficacy by those who have had experience is reflected in the rapidly increasing number of large radium units being set up in the world Paris, which has had a 4 gram unit for some eight years, now has an 8 gram unit Stockholm has a 5 gram unit in addition to one of 3 grams which it has used during the last six years , New York, Chicago, Buffalo and Toronto each has a 4 gram unit Great Britain has lagged behind somewhat in its recognition of the value of 'bomb' treatment, partly because cases are not referred for radium treatment at as early a stage as in many parts of the Continent There have, however, been 1 gram units at the Cancer and Westminster Hospitals in London since 1929, while the Radium Commission in 1933 allocated 1 gram units to both these hospitals as well as to Middlesex and University College Hospitals Edinburgh and Leeds now have also 1 gram units The Radium Beam Therapy Research Board, set up with State support in 1933, is working with a 5 gram unit since 1933

In X-ray diagnosis, short-exposure radiography of any part of the human body offers no difficulties to the experienced With improvement in apparatus and technique, less and less dense bodies can be distinguished, until now the soft tissues and even the extent of tumour growths in them can be depicted Modern fluorescent screens enable digestive movements, heart beats or lung movements to be watched or cinematographed

The physiology of the stomach and alimentary tract has been transformed The presence and extent of internal cancerous growths or small ulcers in the stomach can be definitely established by swallowing barium salt preparations which are opaque to X-rays Extraordinary anomalies, such as the presence of the stomach in the chest, have been so revealed. Much work has been done recently on the injection of opaque fluids into abnormal tracts, the radiographs clearly demonstrating to the surgeon what difficulties and dangers may be encountered in a projected operation. Some organs, for example, the gall bladder and parts of the kidney tract, have the property of concentrating certain administered liquids so that they presently become opaque to X-rays, and thus outline the organs and facilitate the diagnosis of deep internal disease

The X-rays assist in demonstrating the extent of involvement and the type of disease in tuberculosis of the lungs In the treatment of tuberculosis, when by the introduction of air into the chest cavity, the lung has been collapsed to allow it to rest and heal, radiography indicates the state of the lung and when it should be collapsed again Pathological cavities in the substance of the lung are revealed by introducing into the chest lipiodol, which is an oil rendered opaque by iodising it Radiography is a valuable aid in the study of heart disease The heart is sometimes unexpectedly shown to be on the right side of the chest In radiography of the brain, air may be introduced into the cavities of the brain, so locating and outlining in the radiograph the extent of a tumour and consequently indicating where the surgeon must operate

The fine trabecular structure of the interior of bones is plainly revealed by the X-rays Difficult fractures are set under the fluorescent screen, thus assisting in producing perfect restoration of the damaged bone The development of the human embryo is better understood, and radiographs of the unborn child show the centres of the ossification of the bones before birth and are often of invaluable assistance to the obstetrician

The X-ray localisation of foreign objects in the body is a routine matter in hospitals, which are called upon to deal with an amazing variety of objects, for example, coins and safety-pins swallowed by children, dental plates inadvertently swallowed, nails, screws, safety razors, etc, deliberately swallowed by prisoners and others, and legacies from the War in the shape of buried bullets and shrapnel

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Genetics Since 1910

By PROF J B S HALDANE, F R S, Professor of Genetics, University College, London

THE state of genetical knowledge in 1910 can be learnt from Bateson's "Mendel's Principles of Heredity", of which the first two editions were published in 1909 and 1913 The principles which Mendel had shown to hold for seven contrasted pairs of characters in *Pisum* had been extended to a very large number of characters in many plant and animal species, including man The main additions to these principles were the pure line, multiple allelomorphism, partial linkage between genes, epistasy, and one of the four types of sex linkage now known The latter discovery, along with cytological work, had made the genetics of sex determination fairly clear At least one case of extranuclear inheritance had been recorded

Mendel's theory was based on the hypothesis that a (diploid) heterozygote produced two kinds of (haploid) gametes in equal numbers. This has since been proved in cases where the haploid generation has a number of variable characteristics, notably by v. Wettstein in mosses, or where individual haploids can be bred from, as by Andersson-Kotto in ferns In such cases it is found that the products of a single meiosis are always exactly two cells carrying one member of an allelomorphic pair and two carrying the other. When several pairs are segregating, four different haploid types may arise, and a further analysis shows that genetic segregation may be associated with either meiotic division.

The cytological basis of genetics was cleared up by Morgan and his colleagues Bridges, Muller and Sturtevant, working on *Drosophila melanogaster*. They were able to show that the genes were located at different points on the chromosomes. Adequate chromosome maps exist for several species of *Drosophila*, and, thanks largely to the co-ordinative work of Emerson, for *Zea Mays* Less complete maps exist for *Lathyrus* (Punnett) *Pharbitis* (Imai) and other plants By studying the giant chromosomes of the gland cells in *Drosophila*, Painter has been able to correlate the theoretically derived gene map with visible structure, and Muller and Prokofieva have detected visible changes associated with a difference affecting a single gene. Using chromosomes which were microscopically distinguishable owing to the attachment of sections of other chromosomes to them, Stern found that the visible changes in any individual could be predicted from its genetical constitution Thus crossing-over is a physical fact as well as an explanation of genetical phenomena

Similarly, Darlington has shown that there is a quantitative agreement between microscopically visible chiasmata and genetically detectable crossing-over, and has made it probable that these two events, which are really aspects of the same phenomenon, are both due to the relief of strains produced in the chromosomes by coiling. Equally striking is the cytological evidence that abnormal types of linkage are associated with cytologically visible exchanges of parts between different chromosomes (Muller and Altenburg, Hammarlund and Hakansson, Dobzhansky, McClintock, etc.).

Oenothera Lamarckiana and other forms which breed nearly, but not quite, true, have been shown to be examples of permanent heterozygosis. Here the organism forms two kinds of gametes, but only one of the three possible combinations is produced, owing to inviability or competition.

The genetical analysis of *Oenothera* is mainly due to Renner, while Cleland, Darlington and other workers have elucidated its cytological basis, on principles largely suggested by Belling's work Meanwhile Muller built up and analysed a *Drosophila* which behaved like *Oenothera*, possessing balanced lethal genes in two homologous chromosomes

The genetics of polyploids are now understood Gregory studied the genetics of the autotetraploid *Primula sinensis*, which contains four similar sets of chromosomes, and Winge pointed out that hybridisation might lead to an increase in the number of chromosome sets The distinction between autopolyploids with more than two similar sets of chromosomes, and allopolyploids with several unlike sets of pairs derived from different species, was made by Kihara and Ono, while R E Clausen and Goodspeed, Newton and Pellew, and many other authors analysed allopolyploids Müntzing, by his synthesis of *Galeopsis tetrahit* from *G pubescens* and *G speciosa*, was the first to prove that Linnean species had arisen by hybridisation and doubling of the chromosome number The gradual discovery that most cultivated plants are allopolyploids has given this work great practical importance

The origin of new genes by mutation was a rare and uncontrollable process until Muller showed that it could be speeded up at least two hundred times by X-rays Mutations generally lower the viability of an organism, but may raise it (Timoféeff-Ressowsky). They are generally recessive, but sometimes dominant They are at least sometimes reversible by a further dose of X-radiation, and therefore cannot be regarded as mere injuries They can also be provoked to a slight extent by heat, while the possibility of producing them by chemical agencies is still *sub judice*. The majority of mutant genes in animals appear to be lethal when homozygous A proportion of these, including many so-called dominants, produce visible effects in the heterozygous condition.

In the normal type of sex determination one sex has two similar *X*-chromosomes, while the other has a single *X*, or more usually an *X* and a dissimilar *Y*. Besides genes carried by the *X*, the work of the last twenty-five years has disclosed others carried by the *Y* only (Schofield, Castle, Winge, Stern, etc) or by both *X* and *Y* (Schmidt, Aida, Winge, de Zulueta, Philip, etc.) Genetical anomalies of sex linkage occurs in females with an added *Y*-chromosome (Bridges), with attached *X*-chromosomes (L. V. Morgan), translocations of sex-linked genes to other chromosomes, and so on Bridges, by studying triploid *Drosophila*, showed that sex is determined not by the number of *X*-chromosomes but by the balance between them and the autosomes Thus animals with three sets of autosomes are females if they have three *X*-chromosomes, and intersexes if they have two Goldschmidt showed that in *Lymantria* the *X*-chromosomes contain genes making for maleness, the cytoplasm and perhaps other constituents making for femaleness By crossing geographical races of different sex potency he was able to produce intersexes or complete sex reversal In *Lebistes*, Winge has been able to shift the sex-determining mechanism to a different pair of chromosomes, producing *XX*- or *YY*-males instead of the normal *XY*

In Hymenoptera and some other groups the male is haploid Here Whiting and others have shown that all genes behave like the sex-linked (*X*-linked) genes in man But in *Habrobracon* at least, Whiting has proved that there is a further complication, the female being *XY*, the male *X* or *Y*, while *X* eggs are normally only fertilised by *Y* sperm, and conversely Thus genes in the *X*- and *Y*-chromosomes show a fourth type of sex-linkage

Finally, the Thallophyta have shown an astonishing variety of sexuality V Hartmann has found that in some flagellates sex is purely relative, a given type of gamete functioning as male with a less male partner, and conversely, while Kniep found two complementary sex pairs *AB* and *ab*, *Ab* and *aB*, in certain fungi, determined by two pairs of allelomorphic genes Still more complicated cases exist, and it is very difficult to draw the line between sexes on one hand, and exogamous groups of self-sterile hermaphrodite plants, which may be determined as in fungi (Correns) or by series of multiple allelomorphs (East and Mangelsdorf, Lehmann and Filzer, Sirks, Brieger, Crane, etc)

Much work has been done on individuals composed of two or more genetically different types of tissue, including mosaics, gynandromorphs, and plant chimæras They may arise from grafting, double fertilisation, loss of a chromosome, mutation and so on Among the most notable work is that of Morgan and Bridges on *Drosophila*, that of Jörgensen and Crane on *Solanum* and that of Imai on variegated plants

Besides inheritance due to genes, extranuclear inheritance undoubtedly exists The earlier work of Correns on the inheritance of abnormal plastid type has been extended, and other characters transmitted only by the seed parent have been recorded in plants Little finds that the tendency to spontaneous cancer is largely inherited from the mother. However, Michaelis showed that in one such case the cytoplasmic influence gradually disappeared in the course of ten generations, whereas genes in the nucleus show no such tendency. Jollos and Goldschmidt studied *Dauermodifikationen* in *Drosophila* and other animals. These are changes of colour and shape produced by heat, and inherited from the mother only. Unlike mutant genes, they gradually disappear. A good many supposed cases of Lamarckian inheritance of acquired characters have been investigated. Many have been disproved, and none has been conclusively proved. However, the work of McDougall on rats and Sladden on *Carausius*, which suggest inheritance of acquired habits, are still under investigation.

Apart from these rather aberrant cases, there is increasingly strong reason to think that all heritable variation is due to genes. The evidence is particularly strong in *Drosophila* and *Zea Mays*, where characters determined by genes in several different chromosomes can readily be investigated by linkage tests. Fisher showed that the data of the biometric school on inheritance of human stature were consistent with the view that stature is determined by a number of genes, and the work of Punnett and his colleagues on inheritance of weight in poultry and rabbits confirms this view.

Human genetics has consisted largely of the accumulation of pedigrees. Very many genes are known. Thus Cockayne listed more than a hundred affecting the skin, hair or teeth. In addition to abnormalities, the antigens of the blood cells were shown by Landsteiner, Bernstein, Schiff and others to exhibit Mendelian inheritance. In the economic field, sex-linkage has been applied by Punnett, Pease and Crew to determine the sex of young birds on hatching, and genetic principles are used to eliminate recessive lethals in cattle and horses, and to produce new varieties of various plants. But the main economic effect has been from the gradual permeation of genetical principles among practical breeders, which has shown itself for example in the grading of bulls by their daughters' milk yield.

The physiological side of genetics was particularly developed by Goldschmidt, who showed that genes determine the form of the adult by affecting larval growth rates. Kraffka, Huxley, Zeleny, Plunkett and others have investigated the same problem. On the chemical side, Onslow, Garrod, Scott-Moncrieff, Brink and others have shown that in many cases a gene is responsible for some particular chemical process such as oxidation or methylation. The mechanism of segregation is itself controlled by genes (Beadle, Gowen, Frost, etc.), so that a change in one gene may affect the distribution of all the others.

On the other hand, little is known of the nature of the gene. An analysis of multiple allelomorphism shows that different modifications of the same gene perform the same processes at different rates; however, in many cases it is certain that the genes do not consist of a number of like parts. At present the most hopeful line of attack on the fundamental problem of heredity, "How does one gene produce two like itself?", is to be found in the study of mutation, either natural, as in the work of Demerec and Andersson-Kottö, or provoked by X-rays. Andersson-Kotto's work suggests the possibility of distinguishing between a mother and daughter, or model and copy, in the products of gene 'division'.

A possibly important clue to the nature of gene action lies in the fact that, whereas most characters, for example, presence of an organ or a pigment, depend on the interaction of many genes, the presence of an antigen has so far always been found to be due to a single gene. Hence, except possibly in species crosses, no organism contains an antigen not found in either parent (Todd).

The cause of dominance has been much discussed. Bateson and Punnett regarded it as due to the presence in the dominant gene of something absent in the recessive; Fisher believes it to be an adaptive phenomenon due to modifying genes. Many workers take an intermediate point of view.

Naturally polymorphic populations have been investigated, especially by Nabours, Winge and Fryer. The genes concerned are often found to exhibit a surprising amount of linkage with one another. Tschetwerikoff, Dubinin, Spooner and others have shown that an apparently homogeneous population may include many individuals heterozygous for recessive genes producing very marked variations.

The species problem has been attacked from several sides. Vavilov pointed out that homologous variations in similar species generally show similar inheritance, but Harland has shown that there are exceptions to this law, and characters may occasionally be determined by different genes in related species. Sturtevant established a thoroughgoing parallelism in the action and arrangement in the chromosomes of genes in two allied *Drosophila* species.

The differences between some species appear to be mainly due to genes. In the rodents this is so for colour, and Green has located a gene responsible for part of the colour difference between two mouse species in a particular chromosome. Other species differ as regards the number and structure of their chromosomes, and here hybrids, if they exist, are often sterile. In particular, Blakeslee and his colleagues have compared the arrangement of the chromatin in a number of species of *Datura* from this point of view, while Babcock has done the same for *Crepis* and J. Clausen for *Viola*. On the whole, it may be said that while we are fairly clear as to the nature of the genetical differences between related species, and it has been possible to imitate them within a single species (for example, by producing races which differ morphologically and will not cross), we are only rarely able to say with any certainty how species have originated in Nature.

The study of populations has developed a mathematical theory, due largely to Wright, Fisher, Bernstein, Haldane and Norton. The most important problems studied have been the effects on a population of inbreeding, selection, and mutation, and the theory of estimation from samples. These involve among other things non-linear integrals and finite difference equations, and complex theorems in inverse probability. Their general result may be said to favour a modified Darwinian theory of evolution.

It must be emphasised that the main bulk of genetical research has been done by authors not named in this summary, and even where no new principles have been discovered, their work has shown that the general laws laid down by Mendel have as wide a validity for genetics as have Dalton's for chemistry.

Nuclear Structure and Chromosomes

By Prof. R. Ruggles Gates, F.R.S., Professor of Botany, University of London

THE quarter-century of the King's reign has seen many striking advances in cytology, and particularly in our knowledge of the structure of the nucleus and its chromosomes. During the decade ending in 1910, the general theory of 'individuality' of the chromosomes had been established by the work of Boveri and others, the sex chromosomes had been discovered by McClung, and their general relation to sex determined, chiefly by the work of Wilson and his school. These remarkable beginnings definitely linked cytology with genetics and added strength to the view, already accepted in many quarters, that the chromosome reduction in meiosis furnished the physical basis for Mendelian segregation.

An equally notable line of research begun before 1910 was in determining the cytological basis of the mutations discovered by de Vries in *Oenothera*. This work laid the foundation for an analysis of mutations, so that by 1915 it was recognised that each mutation was in effect a cell change handed on by mitosis to every cell of the mutant. It was also recognised at this time that mutations could be classified into various types, which depended for their origin upon different kinds of chromosome change. The process afterwards known as non-disjunction had been discovered in the pollen mother-cells of *Oenothera rubrinervis* in 1908, and by 1912 it was proved that the mutant *Oe. lata* must have arisen by such a process, as it possessed an extra chromosome. Many other *Oenothera* mutations are now known to have an extra chromosome, and the conception of parallel mutations was founded upon the occurrence of *lata* and other mutations in different species.

These chromosomal mutations were regarded by many as convincing evidence of the chromosome theory of heredity. Recently (unpublished), trisomic $(2n + 1)$ mutations have been found occurring on a large scale in a wild species of *Oenothera*. Similar conditions have been observed by Huskins (1927) in fatuoid oats and speltoid wheats, plants with 40, 41, 42, 43 and 44 chromosomes being found where 42 is the normal number, but the exact relation between fatuoidy and the extra chromosome is still undecided. Blakeslee and his colleagues have recognised the twelve trisomic mutants to be expected in *Datura*, which has twelve pairs of chromosomes, as well as a series of secondary forms derived from exchange of segments in the primary trisomics.

In 1907–9 the mutant *Oenothera gigas* was recognised as a cell giant which had doubled its chromosomes. This was the beginning of the enormous modern field of polyploidy, or plants with chromosome multiples. The mutant *semigigas* was found to have 21 chromosomes (triploid) by Stomps and Lutz independently in 1912. Triploidy was discovered in *Drosophila* in 1921 and in *Datura* in the following year. While rare in animals, polyploidy is so widespread in flowering plants that a genus which does not show at least one case of it may almost be regarded as exceptional. Nearly all our cultivated plants, such as wheat, oats, sugarcane, cotton, apples, cherries, tomatoes, potatoes and pineapples, are now known to have varieties or species which possess different multiples of a particular basic number. Among wild species of roses, chrysanthemums, maples, horse-chestnuts, docks, violets, primroses, clovers, ragweeds, strawberries and many others, similar conditions prevail, so that the evolution of many plant genera has clearly been accompanied by the development of higher chromosome multiples from an original basic number, such as $b = 7, 9, 13$ or 17, for the genus. Where $2b$ is the ordinary (diploid) condition, some species may have $4b$, $5b$, $6b$, $10b$, or occasionally even higher multiples.

Thus in the genus *Potentilla*, where $b = 7$, species with $2b$, $4b$, $8b$, $10b$, $12b$, $14b$ and $16b$ are known.

In the cottons, where $b = 13$, it was found (Denham, 1924) that the Old World species had $2b$ chromosomes while the cultivated American cottons have $4b$. More recently, several wild species in Lower California and the Galapagos have been found to be diploid. When and how the chromosome doubling in the cultivated cottons took place is at present unknown.

Wild species with an odd number of chromosome multiples reproduce apomictically, as, for example, the pentaploid roses, the tiger lily, which is triploid, and the triploid day lilies. In large genera there may be several basic numbers, as in *Primula*, where different sections or subsections of the genus have 9, 10, 11 and 12 respectively as basic numbers. Less is known as to how one basic number changes into another, but there is evidence that end-to-end fusion of certain chromosomes, fragmentation and non-disjunction as well as other changes have been at work. In *Drosophila* it seems clear that six pairs of chromosomes, which some species (for example, *D. virilis*) still have, was the original number, this number being diminished to five pairs in *D. obscura* and four in *D. melanogaster* and other species by fusion to form the long pairs. *D. Willistoni* has only three pairs, the small pair having disappeared. Changes in the relative lengths of chromosomes have also been taking place in various genera.

These discoveries regarding polyploidy are fundamental for an understanding of phylogeny, the results of crossing, and various other fields of genetics.

In 1922 Blakeslee discovered haploidy in *Datura*, that is, that an egg cell may develop parthenogenetically to produce a plant having a single set of chromosomes in its nuclei. Such a plant is usually much dwarfed and almost completely sterile, since the chromosomes have no mates and are irregularly distributed in meiosis, but it is significant that it has the morphology of the sporophyte. Haploids have since been discovered in such plants as *Crepis*, tobacco, wheat, tomatoes, *Oenothera*, and in rice, where Japanese investigators have found them to occur with exceptional frequency.

Finally may be mentioned the remarkable cases of amphidiploidy, in which a sterile interspecific hybrid doubles its chromosomes and so becomes in effect a new fertile species with a higher chromosome number. The early case of *Primula kewensis* is now known to be of this character (Pellew and Newton, 1929). *Nicotiana digluta* was produced in this way by Goodspeed and Clausen in 1925 and *Digitalis mertonensis* at Merton in 1928. There is evidence that such cultivated plants as tobacco and the loganberry have originated by similar processes. Remarkable in this connexion is the history of *Dahlia variabilis*, which is native to Mexico and shows a double series of colours as well as the well-known striking morphological variations. It has been shown to be an amphidiploid, the two colour series being contributed by different species (Lawrence, 1929). It may well have originated under cultivation in Aztec gardens.

Even more striking has been the creation of the 'new genus' *Raphanobrassica* by crosses between the cabbage and the radish, each with $n = 9$ chromosomes (Karpechenko, 1924), and *Aegilotrichum* by crosses between *Aegilops* and wheats (Tschermak and Bleier, 1926). Amphidiploids between wheat and rye have also been obtained by Tumyakov at the Saratov station on the Volga, and recently by Lebedeff in the Ukraine, who claims that they reproduce apomictically. If so, this is a further similarity to some of our wild polyploid species in such genera as *Hieracium* and *Antennaria*. The fact that the tetraploid hemp nettle, *Galeopsis Tetrahit*, a well-known Linnean species in the British flora, has been synthesised by crossing two related diploid species, and that the rice grass, *Spartina Townsendii*, which spreads so rapidly in coastal waters, was found to be an amphidiploid hybrid between a British and an introduced American species, shows the importance of polyploidy in phylogeny and in connexion with taxonomic studies. The experimental amphidiploids are new species in every sense of the word, for not only do they breed true in the main, like other species, but they are partially sterile with the species which produced them. The two processes of doubling the chromosome sets and then differentiating them through gene mutations can be traced in many plant genera.

To return to 1910. Morgan published his first mutation in *Drosophila*—red eyes to white—in that year, and in the following year found nine wing mutations and five mutations in eye colour. In 1912 the study of sex-linkage in *Drosophila* began, crossing-over soon came to be studied on an unprecedented scale and in this way more than five hundred mutations have been assigned their relative positions in the four pairs of chromosomes. By 1926 it was possible for Morgan to announce his law that the number of linkage groups corresponds with the number of chromosome pairs. This was confirmed by Punnett for *Lathyrus* in 1927; and in maize, where each of the ten pairs of chromosomes can be identified by its appearance, a map of the genes in each chromosome has been constructed by crossing-over experiments, chiefly by the Cornell school. In 1916, Bridges used cases of non-disjunction of the *X*-chromosomes in *Drosophila* to prove that sex-linked genes were borne in the *X*. Later, he also found individuals with a third member of the tiny fourth chromosome, as well as others having but one member of this pair

Morgan's theory of crossing-over was founded upon Janssen's observations (1909) of chiasmata in meiosis, but exactly how chiasmata are formed and how they are related to crossing-over is still a matter of controversy on which many observations are being made and various views are held

In 1922, L. V Morgan found a strain of *Drosophila* in which the two *X*-chromosomes of the female had become permanently attached end-to-end Before the condition was observed cytologically it had been predicted on the basis of the peculiar breeding results with this strain The condition has since appeared independently in other strains.

Arrangement of the chromosomes of *Oenothera* in a chain at diakinesis was discovered in 1908, and in 1922 Cleland found that the number connected into a ring was characteristic of certain species This condition, which is now known as catenation, is recognised as fundamental to the genetics of *Oenothera*, and the catenation in many species, hybrids and mutations, has been determined It accounts for the usual absence or infrequent occurrence of ordinary Mendelian segregation, the occurrence of 'complexes' of characters, the twin hybrids of de Vries and the fact that heterozygous species breed true In order to account for all these phenomena it is necessary to assume, not only that the chromosomes occupy fixed positions in the ring, but also that they have a fixed orientation This has recently been shown experimentally to be the case The 14 chromosomes of *Oenothera* may be all in a ring or in seven pairs or with various arrangements of smaller rings The fifteen possible groupings (a few unpublished) have now all been observed in different forms of *Oenothera*

Chromosome catenation has since been discovered in a number of other plant genera, including *Datura*, *Aucuba*, *Rhœo* and *Pisum* It can be produced by crossing two Oenotheras each with seven free pairs, and also by crossing certain strains of *Datura* or *Pisum*. Of special interest is the cross between a Tibetan and a European variety of *Pisum* (Pellew and Sansome, 1931) in which a ring of four chromosomes arises. Catenation has also recently been produced in *Oenothera* by exposing the pollen to X-rays The theory of segmental interchange was proposed by Belling and Blakeslee (1926) to account for the chromosome linkage arising in certain *Datura* crosses, and has since been shown to be widely applicable to *Oenothera* and all other cases in which ring formation takes place as a result of crossing.

In 1927 Muller announced that the mutation rate in *Drosophila* could be increased a hundredfold by subjecting the germ cells to X-rays The exact nature of the effect on the chromosomes is still unknown, but in addition to gene mutations, many of which are lethal, chromosome fragmentations, deletions and segmental translocations are produced by this means It has been applied to various plants, notably *Nicotiana*, barley, *Antirrhinum* and recently *Oenothera* There are now many lines of evidence that translocation of chromosome segments can take place in Nature, and it has been shown, for example, by comparing the seriation of the genes in *Drosophila melanogaster* with that in *D simulans*, that a segment of chromosome III in one of these species has been inverted.

Phylogenetic significance also attaches to the secondary pairing of chromosome bivalents in meiosis This was first observed by the Marchals (1911) in mosses in which the chromosome number had been doubled experimentally Hagerup (1927) noted it in a hermaphrodite tetraploid species evidently derived from *Empetrum nigrum* Darlington (1928) used it in interpreting the history of the polyploid cherries Secondary pairing appears to be due to a residual attraction, and indicates that the chromosome bivalents which show it are themselves more distantly homologous In other words, it is an indication of polyploidy or similar processes in the more remote ancestry, and throws light on how chromosome numbers have changed from genus to genus The Pomoideæ, a group of Rosaceous genera, have 17 chromosomes They show secondary pairing and other multivalent associations (Darlington and Moffatt, 1930) which indicate how this number has been derived from an earlier 7, which is characteristic of many genera in the family, such as *Rosa* itself Secondary pairing has been observed also in *Pyrus*, *Dahlia*, *Brassica*, *Gossypium* and many other cases, where it helps to throw light on nuclear phylogeny (Lawrence, 1931)

Important advances have also taken place in regard to chromosome structure, although in this fascinating field many points are still unsettled Most investigators appear to be now agreed that the chromosomes are double in anaphase as well as prophase, from which it follows that the split occurs about the time of metaphase and that the chromosome is a double structure throughout the mitotic cycle. The chromonema theory, according to which the essential part of the chromosome is a thread of uniform thickness, dates from Vejdovsky, 1912 The chromomere theory, of granules aligned like beads on a string, is much older. Both views have strong supporters at the present time and it does not yet appear how their differences will be resolved. Wenrich (1916) found that in grasshoppers particular chromomeres could be identified by their size and position on the chromosome. Belling (1931) identified the chromomeres with the genes, and attempts at counting them in various plants have given values ranging roughly from 1000 to 2500. The chromosome threads become spiral in various stages of mitosis, and Kuwada has found indications of a spiral within the spiral. Others find the spiral chromonema splitting lengthwise in prometaphase.

In what may be called the external morphology of the chromosomes more marked progress has been made. In 1912, S. Navashin discovered that certain chromosomes in *Galtonia* have a tiny more or less globular satellite attached to one end by a thread. One or more pairs of satellited chromosomes have since been observed in many plants and animals.

The spindle fibre attachment constriction is now a well-recognised feature of all plant chromosomes, and 'kinetic bodies', 'knobs', 'heads', additional constrictions, vesicles and their special features have been observed. Levitsky, M. Navashin and others of the Russian school have been active in comparing the karyotypes of various plant groups.

The nature of the nucleolus has long been a mystery, but light has recently been thrown on this problem. Wenrich (1916) noted in the meiotic nuclei of a grasshopper that the nucleolus bore a constant relation to a particular pair of chromosomes. Later a definite 'nucleolar body' was discovered as a darker staining area of the nucleolus in pollen mother cells of *Lathyrus* (Latter, 1926), and it was shown that a loop of the chromosome thread was constantly attached to it. The same condition has since been found in *Lathræa*, *Oenothera*, *Malva* and rice, and frequently two such bodies rather than one are attached to the nucleolus. S. Navashin had observed a pair of satellites attached to the nucleolus, and in studies of maize, McClintock (1931) has shown that the satellited pair of chromosomes is concerned in producing the nucleolus in telophase at a particular locus. When these chromosomes are widely separated, two nucleoli will be produced. Heitz (1931) has observed similar conditions in *Vicia* and other plants as well as in insects (1933), while Dearing (1934) shows in the amphibian *Amblystoma* the same relation between a satellited pair of chromosomes and the (usually two) nucleoli present. Thus it appears to be the function of a particular locus of one pair of chromosomes to produce the nucleolus, but this is not the whole story. In this, as in other fields of nuclear study, the results in animals and plants have been remarkably synchronised.

Lack of space prevents more than mention of the important method of micro-dissection, by which living cells can be dissected with glass needles under an immersion lens. Introduced by Kite and Chambers in 1912, it has led to many interesting observations of the physical condition of various cell constituents, including the chromosomes.

Finally, we may refer to the investigations of the chromosome structure in the salivary glands of insects. These giant chromosomes have long been known to show a banded structure, but its significance has only been brought out by the recent observations of Painter, Bridges, Koltzoff and others. The discs differ markedly in details of structure, but they are definitely spaced at varying intervals along the chromosomes, and from the evidence of their pairing and genetic behaviour it is clear that they must be identified in some way with the genes. Certain of the bands have been shown to vary according to the genetic make-up of the animal. Bridges has just published (*J. Hered.*, 26, No. 2) maps of the four chromosomes (significantly separated into six) in the salivary glands of *Drosophila melanogaster*, identifying each band and also pointing out many other structural features or landmarks at various loci of the chromosomes. These chromosomes total about 1180 μ, or 150 times the length of the meiotic chromosomes. The bands, which probably represent loci, number 2650, the little fourth chromosome having 34. This begins a new era in chromosome study.

Chemistry of the Anthocyanins

By PROF. R. ROBINSON, F.R.S., Waynflete Professor of Chemistry, University of Oxford

THE classical paper of Willstätter and Everest (1913), on the isolation of the pigment of blue cornflowers, heralded a dramatic transformation of the state of our knowledge of the blue and red colouring matters of flowers and blossoms, and the present position is that we not only know the molecular structure of the more important and widespread anthocyanins, but also that many of them have been made artificially in the laboratory. With the simultaneous growth of precise information about chlorophyll, the carotenoids, the polysaccharides and the terpenes, one may say that all the more obvious challenges of vegetative Nature to the organic chemist have been taken up, and taken up successfully. Deep mysteries there are still, it is true, but one must probe beneath the surface in order to find them Willstätter owed his triumph largely to recognition of the fact that the anthocyanins, although non-nitrogenous, form salts with strong acids, and these salts can be purified by means of the technique appropriate to many ammonium salts, that is, solution in a hydroxylic solvent and precipitation with a non-hydroxylic solvent

An early observation records the unconscious use of formic acid for the extraction of an anthocyanin J Wray (1670) wrote "Bare an ant-hill with a stick and then cast the [chicory] flowers upon it, and you shall see the ants creep very thick over them Now as they creep, they let fall a drop of liquor from them, and where that chanceth to light, there you shall have in a moment a large red stain" This was followed up and red extracts of blue chicory flowers were made with acidic solutions

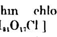
Willstätter and his colleagues extracted the anthocyanin salts by means of methyl alcoholic hydrogen chloride, acetic acid or other similar solvents, and precipitated a crude, often syrupy, product with ether The process was usually repeated, perhaps with variation of solvent, and until the anthocyanin could be caused to separate from aqueous or alcoholic solution as a chloride or picrate Purification was then possible by crystallisation, or a series of separations leading to eventual crystallisation The different examples offered very divergent degrees of difficulty and indeed, in some cases, the skill of the florist in the breeding of deeply-coloured varieties has been such that the dried petals can almost be regarded as crude anthocyanin

The blue cornflower and the red poppy represent the more difficult type, whereas the colouring matter is readily isolated from special deep red varieties of dahlias and chrysanthemums and from certain garden violas The dried petals of the blue-black viola (*Viola tricolor*) employed by Willstätter and Weil (1916) for the isolation of violanin contained no less than 24 per cent of this pigment

Willstatter was fortunate in the selection of material because among the first flowers studied were to be found representatives of the three main types in the group. From the cornflower, the rose and the dahlia he obtained cyanin chloride, $C_{27}H_{31}O_{16}Cl$, which splits up on hydrolysis into *cyanidin* chloride, $C_{15}H_{11}O_6Cl$, and two molecules of glucose; from the scarlet pelargonium he isolated pelargonin chloride, $C_{27}H_{31}O_{15}Cl$, which similarly yields on hydrolysis two molecules of glucose and *pelargonidin* chloride, $C_{15}H_{11}O_5Cl$, whilst the wild purple larkspur afforded delphinin chloride, $C_{41}H_{39}O_{21}Cl$, which gives, on hydrolysis, *delphinidin* chloride, $C_{15}H_{11}O_7Cl$, along with two molecules of glucose and two molecules of *p*-hydroxybenzoic acid [Anthocyanins containing acyl groups, often *p*-coumaric acid (Karrer), are widely distributed and are termed *complex anthocyanins* The true analogue of pelargonin chloride and cyanin chloride in the delphinidin series has recently been isolated from *Salvia patens* (Reynolds, Scott-Moncrieff and R R, 1934), it is termed delphin chloride and has the composition $C_{27}H_{31}O_{17}Cl$]

The aglucones were termed anthocyanidins, and in addition to the three already mentioned only certain of their methyl ethers have been encountered The two or three exceptional cases serve merely to establish the rule that all the anthocyanins are derivatives of the three basic types Further work showed that the aglucones may be combined with one molecule of glucose or of galactose, or with a rhamnoglucose or aldopentoglucose, and that isomeric diglucosides exist Thus mecocyanin chloride (from *Papaver rhoeas*) is quite different from cyanin chloride, but like it has the composition $C_{27}H_{31}O_{16}Cl$, and it also furnishes cyanidin chloride and two molecules of glucose on hydrolysis

The probable nature of the difference between pelargonidin, cyanidin and delphinidin is clearly indicated by the results of fusion with potash All three give phloroglucinol (I) as one of the products,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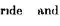
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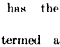
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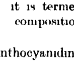
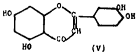

(IV)

but pelargonidin was in addition degraded to *p*-hydroxybenzoic acid (II), cyanidin to protocatechuic acid (III) and delphinidin to gallic acid (IV)

Taking into consideration the results of precedent investigations on natural flavones (luteolin, V) and flavonols (quercetin, VI) with which the names of Kostanecki, A G Perkin and Herzig are chiefly associated, and also the accumulated knowledge of the properties of flavylium salts (such as VII) (Collie, Werner, Bulow, Decker, W H. Perkin and R R), it was apparent that the facts pointed to the formula VIII for cyanidin chloride The formulæ for the other anthocyanidins would be derived by modifications of the group A in VIII to conform with the results of potash fusion as mentioned above

This surmise was quickly justified by the discovery that flavones and flavonols could be reduced by metals in acid solution with the formation of oxonium salts having the reactions of anthocyanidins (Everest, Willstätter) In particular, Willstätter and Mallison showed that quercetin gives a small yield (0 6 gm. from 30 gm) of pure cyanidin chloride when it is reduced in aqueous methyl alcoholic hydrochloric acid by means of magnesium (VI → VIII) This was followed up by a more formal synthesis of pelargonidin (Willstatter and Zechmeister), whilst the present writer and his collaborators have synthesised all the anthocyanidins, including the methyl ethers, by convenient and generally applicable methods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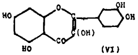
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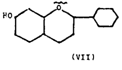
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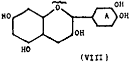
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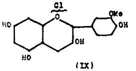
The naturally occurring methyl ethers of the anthocyanidins are peonidin chloride (IX), the aglucone of peonin, a diglucoside, and oxycoccicyanin, a monoglucoside , petunidin chloride (X), the aglucone of petunin chloride, a diglucoside , malvidin chloride (XI), the aglucone of a monoglucoside, a monogalactoside, a diglucoside, and of complex anthocyanins , hirsutidin chloride (XII), found only as the aglucone of hirsutin chloride, a diglucoside of *Primula hirsuta* (Karrer) Of these, malvidin, also called syringidin and œnidin, is of such frequent occurrence that it almost deserves recognition as a fourth fundamental type Its monoglucoside is œnin, the pigment of black grapes, one of the most frequently studied anthocyanins.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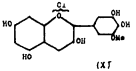
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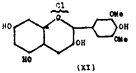
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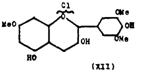
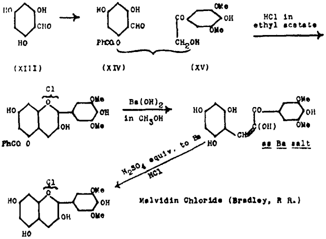

(XII)

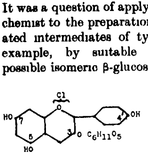
In the earlier work on anthocyanidin syntheses (Pratt, R.R.) it was thought necessary to protect the nuclear hydroxyl groups very completely, and the products were finally demethylated by means of hot hydriodic acid Such a process could clearly not be applicable to the methyl ethers (IX–XII), and a technique has been gradually evolved that allows of the minimum of protection, and that by means of acyl groups only The scheme below illustrates the stages of the synthesis of malvidin chloride by the best-known method

Phloroglucinaldehyde (XIII) may be synthesised from carbon *via* five isolated intermediate stages, namely, acetylene, benzene, nitrobenzene, trinitrobenzene, phloroglucinol ; hydrocyanic acid is also used and may be obtained from carbon in two stages The intermediate XV may be synthesised from carbon in thirteen isolated stages, namely, acetylene, benzene, benzoic acid (better in one more stage), disulphobenzoic acid, 3 5-dihydroxybenzoic acid, bromodihydroxybenzoic acid, gallic acid, trimethoxybenzoic acid, syringic acid, acetylsyringic acid, acetylsyringoyl chloride, diazodimethoxyacetoxyacetophenone, ω-4-diacetoxy-3 · 5-dimethoxy-acetophenone , two carbon atoms are introduced by way of carbon monoxide, methyl alcohol, methyl sulphate, and one from carbon monoxide, methyl alcohol, methylamine, methylurea, nitrosomethylurea, diazomethane



The monobenzoylphloroglucinaldehyde (XIV) has been found to be a particularly convenient first component in all syntheses of the above type, and its use (Robertson, R R.) facilitated the synthesis of the anthocyanins themselves. Hints in regard to the site of the sugar residues in the anthocyanins had been obtained from a study of their colour reactions and other properties (Willstätter, Karrer, R. R and their colleagues) in comparison with synthetic, analogous flavylium salts, but it is unnecessary, in this brief article, to recount the arguments, especially as none of them was conclusive. The case is one in which synthesis has been applied not merely to the confirmation but also to the determination of structure.

Nor is it necessary to mention the several stages of approach to the synthetic method, which is identical in principle with that already described. It was a question of applying the art of the organic chemist to the preparation of the various glucosidated intermediates of types XIV and XV. For example, by suitable modifications the four possible isomeric β-glucosides of pelargonidin were



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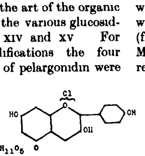

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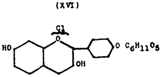
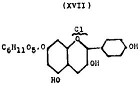


(XVIII)



(XIX)

synthesised (XVI, XVII, XVIII, XIX) (Robertson, Léon, Seshadri, R. R.); XVI was found to be identical with Willstatter's callistephin and XVII with his pelargonenin, not a natural anthocyanin but the first product of the hydrolysis of the diglucoside, pelargonin.

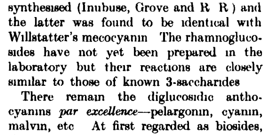
The natural monoglucosidic anthocyanins are all constituted like XVI. The naturally occurring mono-glycosides synthesised are callistephin (from the aster or red carnation), chrysanthemin (cyanidin 3-glucoside from the chrysanthemum and other flowers), oxycoccicyanin (peonidin 3-glucoside from American cranberries), œnin (malvidin 3-glucoside from purple-black grapes), fragarin (pelargonidin 3-galactoside from strawberries), idæin (cyanidin 3-galactoside from European cranberries), primulin (malvidin 3-galactoside from *Primula sinensis*). The last-mentioned case is of interest because it illustrates the value of one of the methods used for the characterisation of anthocyanins. The monoglucosides are distributed between dilute hydrochloric acid and *iso*amyl alcohol, but the distribution number varies with the concentration. By plotting the logarithms of the concentrations in the aqueous and alcoholic layers against each other, a straight line is obtained with a slope of 2; this indicates that double molecules exist in the water and single molecules in the *iso*amyl alcohol. The curves obtained in this way are much more reliable than single determinations of the distribution numbers because they afford evidence of homogeneity.

In connexion with work on the bilberry pigments, malvidin 3-galactoside was synthesised (Bell, R. R.), and its distribution properties were found to differ from those of œnin (malvidin 3-glucoside), so that a study of malvidin 3-glycosides containing unidentified sugar residues was feasible. Cyclamin (from cyclamen, Karrer) was found to be identical with œnin, but primulin (from *P. sinensis*), isolated by Miss R. Scott-Moncrieff, tallied with the galactoside. Closely related to the monoglycosides are the true biosides, and one example has been cleared up by synthesis. Cyanidin 3-cellobioside, 3-maltoside, 3-lactoside and 3-gentiobioside were synthesised (Inubuse, Grove and R. R.) and the latter was found to be identical with Willstatter's mecocyanin. The rhamnoglucosides have not yet been prepared in the laboratory but their reactions are closely similar to those of known 3-saccharides.

There remain the diglucosidic anthocyanins *par excellence*—pelargonin, cyanin, malvin, etc. At first regarded as biosides, these are now known to be di-monoglucosides, and the two sugar residues are attached to different hydroxyl groups of the anthocyanidin molecules.

The suggestion that they are 3 : 5-diglucosides was first put forward in a letter to the Editor of NATURE (G. M. R. and R. R.) and it was quickly confirmed by synthesis. The glucose rests must be introduced into both components. Normally and preferably these were acetylated, and the product was submitted to hydrolysis by alkali and reconstituted by the action of hydrochloric acid.

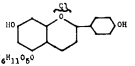
It is perhaps a matter of interest that cyanin chloride (XX) has been synthesised directly from unprotected components (Rosuggan, R. R.)



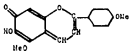
(XX)

The naturally occurring 3.5-diglucosides synthesised include pelargonin, cyanin, peonin, malvin and hirsutin (Todd and R. R.); the additional case of delphin has been mentioned already.

The possession of pure synthetic specimens of the anthocyanins and anthocyanidins has made it possible to devise simple tests for the rapid recognition of the nature of the pigments in crude extracts of plant material, and a survey (G. M. R. and R. R.) has been made of a wide variety of flowers and other parts of plants in respect of their anthocyanin content In general, we are able to specify the anthocyanidin and the position of the sugar groups, but the latter cannot be identified (except for rhamnose and the aldopentoses) This survey has made the dominating position of pelargonidin, cyanidin, delphinidin and malvidin even more clear, but it has also disclosed the occurrence in Nature of certain widely distributed anthocyanins not yet isolated in substance As examples, the pelargonidin 3-bioside of the orange-red nasturtium and the pelargonidin 3-rhamnoglucoside of the scarlet gloxinia may be cited The orange-scarlet flowers of *Gesnera fulgens* were found to contain a new anthocyanin termed gesnerin , it is apigeninidin 5-glucoside (XXI) and has been synthesised (Todd, G M R and R R) , it is the only known anthocyanin related to a flavone rather than to a flavonol, although carajurin (XXII), a crystalline constituent of a cosmetic pigment used by the natives of the Orinoco, is a colour-base of such a substance (Chapman, A. G Perkin and R R) Other special types of anthocyanins are the nitrogenous pigments of *Beta*, *Bougainvillœa*, *Amaranthus*, *Celosia*, etc , their nature has not been fully elucidated , also the bright yellow water-soluble colouring matters of *Papaver alpinum* and *P nudicaule*



(XXI)



(XXII)

Among the matters of more general interest connected with the anthocyanins are the causes of colour variations in flowers, considered both statically and dynamically, that is, the actual condition of the pigment on one hand and its relation to genetic factors on the other On the first aspect it may be noted that the pigments are indicators, the colours ranging from red oxonium salts to blue or violet salts of the colour-bases which are also acids Thus cyanin chloride has a beautiful bluish-red colour, cyanin-base is violet and the potassium salt of cyanin-base is blue Naturally, therefore, the colour of a flower is dependent on the *p*H of the cell-sap. But the range of *p*H is much smaller than experiments *in vitro* would suggest, and this is due to the combination of the anthocyanin colour-base with colloids tending to stabilise the anthocyanin anion at a *p*H which it could not survive in 'clean' solutions.

Another factor modifying the conclusions drawn from the indicator ranges observed in the laboratory is the presence of co-pigments in the flowers. These are organic substances, mainly flavonols and tannins, which have a blueing effect on the colour irrespective of the *p*H The magnitude of the effect is, however, dependent on the *p*H and at a certain value becomes maximum The phenomenon is the result of actual combination with the pigment and is accompanied by a marked change (diminution) of the distribution number

A very characteristic reaction of cyanidin, petunidin and delphinidin derivatives is the deep blue ferric reaction The presence of iron in the cell-sap might, therefore, be responsible for blue colours Recent analysis of blue and red hydrangea flowers by Manly have been interpreted in this sense, and although this popular problem cannot be said to have been completely solved, the presence of iron and other metals must be reckoned with in considering the factors responsible for flower colours

On the genetical aspect little need be said here , the subject deserves a separate treatment Obviously the anthocyanin approach to the study of heredity represents one of the most promising lines of investigation, and it will be greatly facilitated by the chemical advances here briefly summarised Miss Scott-Moncrieff and her colleagues have recently completed an investigation of the dahlias (private communication) which goes far to show that the pelargonin, cyanin and flavone or flavonols occurring in these flowers are biogenetically complementary and are phytosynthesised from a limited supply of protoflavan material The full details will be studied with interest, and this type of investigation is pregnant with possibilities in connexion with the elucidation of the mechanism of anthocyanin synthesis in the plant

I consider that the identification of the anthocyanin-chromogen with the flavones was an unfortunate obsession of the plant physiologists, and that in a different form the oxidase hypothesis of Keeble and Armstrong will be revived.

The leuco-anthocyanins of Laborde, Rosenheim and others will probably be found to be much nearer the mark These substances are even more widely distributed than the anthocyanins (G. M. R and R. R.), and their constitution may be foreshadowed by an investigation of peltogynol recently carried out in these laboratories (G M. R and R R.). This is a constituent of certain woods known as 'purpleheart', and it is essentially a dihydrodesoxycyanidin condensed with formaldehyde. It is thought that the leuco-anthocyanins as a class may be of similar nature, the sensitive partly reduced flavylium nucleus being protected in a semi-acetal sugar-like structure.

Adsorption Concepts in Chemistry

By PROF. ERIC K. RIDEAL, F.R.S., Professor of Colloid Science in the University of Cambridge

NO better perspective of the development of our knowledge concerning adsorption at surfaces can be obtained than by contrasting the contents of one of the many monographs published on this subject in recent years with the considered views of Nernst, as expressed in the sixth edition of his famous textbook in theoretical chemistry, which appeared twenty-five years ago. At that time the process of adsorption on surfaces was regarded essentially as due to the formation on the substrate of a dense atmosphere-like layer many molecules thick. Of this concept no vestige remains. Whilst the fundamental qualitative expressions of the more modern views are essentially simpler and more direct than the old, yet the detailed processes are undoubtedly complex and still await complete elucidation.

Two fundamental concepts introduced some twenty years ago, envisaged by the late Sir William Hardy, but most clearly presented and demonstrated by Irving Langmuir, have had the greatest influence in moulding our present views. The two ideas that the forces acting in the process of adsorption are to be recognised as identical with those operative in ordinary chemical processes, and that in molecules, especially in large organic molecules, certain portions are more reactive than others, form the basis of the modern concept of the orientated monolayer as the model of the adsorbed phase.

The reality of the existence of adsorbed materials in the form of orientated monolayers both on solid and liquid surfaces has now been demonstrated by chemical, optical, electrical and thermal methods. More detailed examination has revealed the fact that on liquid surfaces the material in the adsorbed monolayer can, like material in three dimensions, exist in various physical states akin to three dimensional vapours, liquids and solids, and that these phases can be transformed into one another each with its own definite change in free energy of transformation.

Examination of such monolayers on liquid surfaces by means of the Langmuir trough, and by determination of the phase boundary potential, now provides us with some information supplementary to the examination by X-rays as to the configuration of complex molecules like the sterols or proteins. It is also possible to measure the rate of reactions proceedings in these films, for example, such processes as enzyme reactions, chemical reactions involving hydrolysis, oxidation or two dimensional polymerisation. These reactions proceeding in monolayers at fluid interfaces are of great interest, in that not only may they be the prototype of a number of important biological chemical reactions which occur *in vivo*, but they also permit us to alter at will by mere compression or expansion the rate of reaction proceeding in the film, visual evidence of the reality of the factor termed the steric factor in homogeneous reactions.

A much greater variety of phenomena is met with when investigating adsorption at solid surfaces. Two distinct types of adsorptive processes are generally recognised, in one the forces holding the molecule to the surface originate in the mutual polarisation of the molecules and are frequently termed physical or Van der Waals' forces. In suitable circumstances an electronic switch occurs and a chemical reaction takes place between the adsorbed molecule and one or more molecules of the substrate, forming a chemiadsorbed complex. It is customary to consider chemical compounds as belonging to one or other of the extreme types, one where the stability of the compound is due chiefly to the operation of coulomb forces between ions and the other where a bond or a valency force in the form of a pair of electrons is shared between two atoms in a binary compound. We may cite the adsorption of the rare gases on mica, of cæsium on tungsten and oxygen on tungsten as typical representatives of these three types of surface compounds existing in the adsorbed phase.

Whilst the molecules in a distended adsorbed phase on a liquid substrate can move freely over the surface by diffusion, such is not the case on a solid surface, where the adsorbed molecules must migrate *per saltum*, a process termed activated diffusion. Such activated diffusion is not always limited to the surface of the solid, for frequently the process of adsorption is complicated by penetration into the solid through fissures, along slip planes, into large molecular holes, as obtain in the zeolites, or actually into the lattice of the solid itself, and in some cases it is possible to trace the changes in the mode of gas flow inward from simple diffusion to activated diffusion as the fissures change in size and the temperature is varied. As we have noted, the elimination of forces other than Van der Waals' and chemical in adsorption phenomena, does not permit of the assumption of the existence of an atmosphere-like thick adsorption layer, yet thick layers can be built up under suitable conditions by the operation of these short-range forces alone ;

thus relatively thick layers of sodium can be deposited upon tungsten It is possible that these are not intrinsically stable and may actually aggregate into drops embedded in a monolayer, as occurs when a relatively thick film of oleic acid is deposited on the surface of water Evidence for the formation of a second layer on the top of a first has often been brought forward, and indeed this phenomenon may be of frequent occurrence, thus a layer of oxygen molecules may be held on to the top of a layer of oxygen chemi-adsorbed on to tungsten The second layer is of course 'held' less tightly than the first, in consequence the second layer may be but sparsely populated under conditions when the first is almost complete, and molecules in the second layer may be much more mobile than the atoms or ions in the first It is indeed due to the surface mobility of the oxygen in this second layer that a tungsten wire becomes coated so rapidly with a chemi-adsorbed layer in oxygen at low pressures The adsorbed oxygen in the second layer moves over the surface and drops into any vacant hole in the chemi-adsorbed layer beneath

More recently, evidence has been brought forward that when gases, or more generally, vapours, are adsorbed by the operation of Van der Waals' forces, the adsorbed layer may exist under suitable conditions in more than one state, thus it is possible to describe phase changes on solid surfaces as due to two dimensional liquefaction or solidification from a two dimensional vapour phase

Similar phenomena are met with in cases of chemi-adsorption, but here the lateral attractive and repulsive forces between the adsorbed ions or dipoles, and their variation with the changes in the density of population, are great enough both to make a thorough study of the conditions of equilibrium in these two dimensional chemical systems on solid substrates an extremely complicated problem and to render the interpretation of the experimental data difficult

Adsorption of gases by solids is not always an extremely rapid process but may, over suitable temperature ranges, proceed with measurable speeds From the influence of temperature on the rate of the process, energies of activation may be calculated In many cases this slow process, requiring a definite energy of activation, can be ascribed to the slowness of the process of conversion of the Van der Waals' adsorbed molecules into the chemi-adsorbed complex, and for this reason chemisorption is frequently termed activated adsorption, although in a number of cases the process of chemi-adsorption, like many elementary reactions, can proceed with a negligible energy of activation.

A closer analysis of the problem suggests that there are at least three distinct processes where energy barriers may be involved, that is, three different energies of activation may have to be distinguished These are first, the transition of the Van der Waals' adsorbed molecule to the chemi-adsorbed state, secondly, the transition of a molecule or atom of the exterior of the solid to a place just inside the solid, and thirdly, the migration of this molecule farther into the interior

In many cases where the process of adsorption is proceeding slowly, it is a matter of some difficulty to find out which of these three energy barriers is actually responsible for controlling the speed of the reaction actually being measured

It seems certain that in many cases, where diatomic gases such as hydrogen, oxygen or nitrogen undergo the process of chemi-adsorption at metallic surfaces, a reaction occurs which is the preliminary stage in a number of heterogeneous catalytic reactions, some of these being of great industrial importance The resulting chemi-adsorbed complex involves only one atom of the gas undergoing chemi-adsorption Thus chemi-adsorption involves a process of dissociation of the molecule The application of the principles of the wave mechanics to the theoretical aspects of this problem suggests that the energies of activation should vary with the spacing or distance apart of the atoms forming the substrate Whilst the experimental evidence so far produced may be said to support this view, it has not yet been tested in a manner sufficiently rigorous to affirm the correctness of this important theoretical conclusion

Twenty-five years ago, no distinct ideas as to the mechanism of catalytic reactions at solid surfaces could be said to have been formulated The chemical view, which postulated the formation of intermediate compounds, could be found side by side with what might be termed a physical view, where it was supposed that the molecules in the condensed atmosphere not only collided more frequently but also the forces opposing reaction were in some mysterious way reduced to smaller magnitudes At the present time, it may be said that the chemical view has been fully substantiated, the catalyst provides by chemi-adsorption an alternative chemical path. Surface hydrides, oxides, nitrides, and more complex compounds—for example, such as are formed by chemi-adsorption of olefines on carbon—are known, and their properties have been examined Much further work is required before the detailed kinetics of these processes can be said to be definitely established, but it is clear that during the last twenty-five years the crops from the field thrown open by Hardy and Langmuir have been good, and bumper harvests may be expected in the future.

Food Storage and Transport

By DR FRANKLIN KIDD, Superintendent of the Low Temperature Research Station, Cambridge

THE state of affairs to-day with regard to the transport and storage of foods is very different from what it was twenty-five years ago The bulk that is handled is very much larger and the variety is much greater, and transport and storage are conducted over longer times and distances

Putting aside canning and drying as methods of preservation, and considering fresh foodstuffs only, this development has been due to the application of refrigeration over a wider and wider field

The success that has attended this development is founded on the intelligent grasp that has been everywhere shown of the fact that the use of low temperature as such is in itself only the widest of general principles Each type of foodstuff, be it fresh fish, meat, fruit or vegetable, is an infinitely complex material and subtly varying according to its growth and development The last twenty-five years have seen a great extension of our knowledge of the laws governing the changes in these organisms in their living and post-mortem states. To-day, scientific attention is given not only to the question of temperature control and to the maintenance of low temperatures during storage, but also to every stage of the pre- and post-storage history, with the object of producing foodstuffs, after long storage and transport, indistinguishable in appearance, palatability, digestibility and physiological value from the original fresh material.

A single example may be interesting here in illustration. It must be generally known what a difficult fruit the William pear is to handle even when grown in one's own garden It seems almost incredible that thousands of tons of this choice fruit should be successfully shipped in bulk to Great Britain from South Africa, California and Australia. This success could not be achieved unless in the first place an elaborate scientific technique existed for the proper production of the fruit, free from all blemishes: if the exactly right time for gathering the fruit based on a variety of tests had not been chosen: if the fruit had not been wrapped and systematically packed in cases by methods which have been evolved and standardised as a result of a long process of experiment and observation: if the fruit had not been rapidly cooled in special pre-cooling stores in the country of origin, if afterwards it had not been carried, of necessity in bulk, but with the arrangements of stowage and refrigeration by forced air movement so adjusted as to maintain a uniformity of temperature throughout the hold to within 1° F: and if finally, the fruit had not been properly ripened at a controlled high temperature after arrival in Great Britain in the winter months Disasters occur even to-day through failure in one or other of the links in this chain

Chilled beef is another good case in point illustrating this type of development The degree to which the quality of imported chilled beef approximates to that of the best 'home-killed' depends not only on the maintenance of the low temperature, but also its maintenance to within 0 5° F during shipment upon the proper breeding, feeding, resting and watering of the cattle before slaughter and above everything upon the utmost care in the maintenance of hygienic conditions during the dressing of the meat Bacterial counts are now made at the time the beef is chilled, and from these the condition of the meat on arrival after transport can be almost precisely foretold

One line along which much progress has been made is in the definition of the optimum temperatures for storage, and this is so principally with regard to fruit, and with regard to frozen fish and meats As a general principle, all fruits and vegetables have what is termed a low temperature tolerance limit They cannot of course be frozen without damaging the essential organisation of the fresh product Even above the freezing point, however, they cannot be stored too long below their tolerance limit without suffering from some form of functional breakdown and disorganisation Many types of breakdown of this class have now been detected and described in various fruits, and in a large number of cases the optimum temperature of storage has been accurately determined

In the case of frozen fish and frozen meats, scientific analysis has brought to light the fact that changes affecting solubility of the proteins occur most rapidly between − 2° C and − 3° C, and it has become clear that the dry tasteless condition previously encountered in frozen fish and certain meats can be avoided and the fresh state almost completely preserved if, in freezing and thawing, the material is taken rapidly enough through a critical range of temperatures below the freezing point, and if during storage it is held at a temperature between − 20° C and − 30° C.

One of the results of this discovery has been to open up a new source of fish supply to Great Britain Large vessels equipped with rapid freezing equipment and large storage capacity are able to spend months away from port on the west coast of Greenland fishing for halibut and cod. An even more recent development, still in the experimental stage, is the preservation of a proportion of the herring harvest by quick freezing and low-temperature storage for subsequent, out of season, kippering and other uses

So far we have dealt with what might be described as improvements in the technique of storage by the use of low temperature A revolutionary development which has taken place within the last twenty-five years, a development which is probably even now only in its infancy, is the regulation of the composition of the atmosphere as an additional or accessory means of controlling biological change

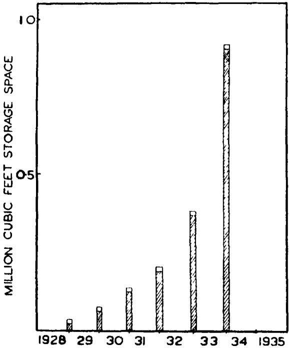


FIG 1 Increase in the capacity of gas-storage for apples in England, since 1929

The idea of using an inert gas for the better preservation of foodstuffs is, of course, an old one Modern developments in Great Britain may be said to have started with a series of papers which appeared in the *Proceedings of the Royal Society* in 1914–15, dealing with the respiration and germination of seeds as affected by oxygen concentration and carbon dioxide concentration. The Food Investigation Board, founded in 1917, took up from the beginning a systematic study of the question of applying the principle of atmosphere control to the storage and transport of food. In the first place, investigations were confined to fruit and fruit-rotting fungi The first commercial fruit store employing the combined control of the temperature, oxygen and carbon dioxide content of the air was installed in Kent in 1928, and since then the adoption of atmospheric control in fruit stores (gas-storage) has been rapid in Great Britain (Fig 1)

The effectiveness of the method is due to several facts The majority of English apples have a relatively high low-temperature tolerance limit, so that cold storage is not effective in the majority of cases for preservation beyond Christmas or January The rate of ripening is a function of the rate of respiration, and this can be retarded not only by lowering the temperature, but also by reducing the oxygen content of the air and by raising the carbon dioxide content There are, however, strict limits to which either operation can be safely carried without injuring the fruit. Carbon dioxide has a specific effect also in delaying the onset of what is known as the climacteric, a critical change of state which precedes the ripening changes of softening, and odour and flavour development

Twenty-five years ago, owing to the length of the voyage, the transport of chilled beef from Australia to Great Britain was an outstanding and apparently insoluble problem The limit for chilling was set by the activity of the micro-organisms—bacteria and moulds Could the rate of growth of these organisms be sufficiently reduced by any concentration of carbon dioxide which could safely be used without itself spoiling the appearance of the meat ? Laboratory experiments on the types of micro-organisms concerned, at the temperatures of chilled beef carriage, indicated that the life of the beef would be approximately doubled by employing an atmosphere containing 10 per cent carbon dioxide Simultaneous investigations showed that this concentration would be without appreciable effect upon changes in the fat leading to rancidity or those in the hæmoglobin leading to browning In 1933, the first shipment of gas-stored chilled beef was brought from New Zealand, and to-day there is an established trade in good quality chilled beef from the antipodes to Great Britain

The possibilities of atmosphere control are not limited to those dependent upon carbon dioxide and oxygen effects upon organisms—fruits, vegetables and micro-flora. As the result of the analysis of the critical part played by oxygen in the breakdown of unsaturated fatty acids and the production of certain types of rancidity, many types of dry foodstuffs containing fats are to-day packed in gas-tight containers from which oxygen is excluded. In the storage of bacon or cured pigs' flesh, this type of oxidative rancidity is usually the limiting factor, and storage in the chilled or frozen state does relatively little to retard these oxidative changes in fat. They can, however, be eliminated by the use of atmospheres free from oxygen and containing a high carbon dioxide content, and by this method bacon can now be successfully stored for months as compared with weeks previously possible

Other improvements in the science and art of food storage and transport are dependent upon the use in special cases and for special purposes of atmospheres containing regulated traces of such gases as ozone, ethylene and ammonia Ozone removes undesirable substances from storage atmospheres, such as the 'volatiles' of ripening fruit, which in too high a concentration are harmful to the fruits themselves or 'taint' other products stored afterwards or simultaneously in the same space Ozone can also exercise a retarding effect on bacterial and mould growth Ethylene is used specifically to stimulate in fruits the climacteric change alluded to above, so that large quantities can be brought uniformly to the optimum stage of ripeness at the time desired Ammonia retards the germination of spores of decay organisms always unavoidably present to a greater or less extent on the surface of all kinds of fresh foodstuffs

In broad retrospect, the past twenty-five years appear as an era in which scientific and practical skill has achieved remarkable results in extending the scope of storage and transport as regards the prevention of wastage By a continuance of the same general methods—that is to say, progressive and intensive scientific analysis of the properties and behaviour of foodstuffs of all kinds and the close linking of practical application with new discovery —the next twenty-five years should see, I think, as great an advance in the quality of products as the past twenty-five years has witnessed in their quantity and variety.

Special Steels

By SIR ROBERT HADFIELD, Bt, F.R.S.

INTRODUCTION

THE author regards it as a privilege to be invited to review in these columns the general progress of special or alloy steels during the first twenty-five years of His Majesty's reign His pleasure in accepting this invitation is further increased by the fact that he had last year the honour of being one of the deputation from the Iron and Steel Institute to present His Majesty with the Bessemer Gold Medal, which he graciously accepted In doing so, His Majesty was following a precedent established by Queen Victoria and continued by King Edward VII, to whom in 1906 the author himself had the honour of presenting the Medal on behalf of the Iron and Steel Institute Thus for three generations the Royal Family has demonstrated its concern and interest for the welfare and progress of the iron and steel industry, upon which the prosperity of our country and its position in the world so largely depends.

Within the limits of space here available, it is not possible to give anything approaching a complete survey of advances in the vast field of special and alloy steels during the past quarter of a century The story is in fact one which begins much earlier and shows during this notable period of industrial activity the vigorous expansion of the era of alloy steels, which at its commencement had become well established but was then comparatively young In 1929 the world's output of steel, then at its maximum production, was 120 million tons, of which no less than about 6 million tons represented alloy steels

In reviewing progress in this period of twenty-five years it is necessary, therefore, to take account both of those newer alloy steels which it has seen initiated and also of the developments which have taken place in the use of those which had already found practical application

The author's discovery and invention of manganese steel in 1882, as expressed by so many well-known metallurgists, marked the dawn of the age of high alloy steels The extraordinary and valuable results then obtained led him to investigate in many other directions this hitherto practically unknown field, and later he was followed by numerous other investigators. To-day manganese steel, with modern improvements in manufacture, is used throughout the world in increasing quantities and for a greater variety of purposes than ever before In addition, there have been developed corrosion- and heat-resisting steels, high-speed tool steels, special steels for armaments and ordnance, special structural steels, high tenacity steels, and steels with remarkable magnetic properties, whether as regards low energy losses in electrical machinery and apparatus, specially high permeability at low magnetisations, or special suitability for permanent magnets, as the case may be The arts of peace have been served in no less measure than the needs of national defence, and progress has been astonishingly rapid in all the branches of metallurgical knowledge concerned

MANGANESE STEEL

Much progress has been made, and many difficulties overcome, in the production and applications of manganese steel since the original specimens of this material were exhibited by the author at the reading of his first paper on this subject before the Institution of Civil Engineers in 1887, that is, almost exactly forty-eight years ago This alloy, now known throughout the world as the Hadfield manganese steel, consists of a non-magnetic alloy of iron with from 11 to 14 per cent of manganese and about 1 25 per cent carbon, and remains one of the most remarkable ferrous materials yet produced, whether from the point of view of practical application or scientific interest

Whilst the general progress of metallurgy has brought about improvement in the actual manufacture of the material, as also its heat treatment which plays such an essential part in the full development of its qualities, this important alloy, manganese steel, remains exactly the same as when originally invented in 1882

SILICON STEEL

The history of the development of this remarkable steel, invented by the writer in the latter portion of the nineteenth century, and how the early difficulties attending its introduction and production, including the best and most suitable proportions to be used of the element silicon, also heat treatment, were surmounted, are given very fully in his book "Metallurgy and its Influence on Modern Progress"

Since its first employment early in the present century, silicon steel has become of the highest importance in the electrical industry by its use in transformers, generators, motors and many other purposes. Without the use of silicon steel, the efficiency of electrical generation and transformation would be seriously lower than at present and many modern designs of electrical plant would be physically impossible owing to the increased energy losses

The hysteresis loss of this steel is initially about two thirds that of unalloyed iron, and actually decreases during a period of years in service. Its high electrical resistance, about six times that of iron, is also of great advantage in minimising losses due to eddy currents, while its maximum magnetic permeability is about 25 per cent higher than that of iron

CORROSION-RESISTING STEELS

The remarkable developments in corrosion-resisting steels, as also in heat-resisting steels to be referred to later, have taken place entirely within the past twenty-five years Several varieties of specialised types have been developed to meet different requirements There are many applications in chemical and other industries for materials combining resistance to corrosion with the mechanical properties of steel, that is, apart from the use of some of these special alloy steels for domestic and ornamental applications No single steel yet developed meets all possible requirements in this field, but many special steels have been perfected, and from these it is generally possible to choose one which is effective against any particular one or more of the many corrosive agencies encountered in industry

The simpler and original type of corrosion-resisting steel, usually termed 'stainless' steel, established by Brearley, containing 12–14 per cent of chromium and from about 0 05 per cent up to about 0 40 per cent of carbon, also still higher percentages such as 16–18 per cent of chromium, according to the purpose for which they are intended, have valuable mechanical properties, and are specially suitable for applications in which the corrosive action is of the ordinary kind, that is, due to air and water For chemical and other applications where a wider range of resistance to corrosion is required, the steels most generally used are of the nickel-chromium type, low in carbon and with from about 12–20 per cent of chromium and about 7–12 per cent of nickel, and in certain cases also small additions of elements such as tungsten, molybdenum and titanium, and other elements are being investigated such as columbium These materials are now available in castings, forgings, rolled sheets or bars, tubes and wire , also by machining, pressing, welding and other methods of assembly they can be fabricated into practically any form desired.

The development of non-rusting steel covers an exceedingly wide field and those specially interested in the history describing its origin and rise are recommended to refer to Chapter ix of the author's book "Faraday and his Metallurgical Researches" where the later development of alloy steels is dealt with.

Steels of this type are now used widely for tanks, pans and other parts of chemical or other manufacturing equipment exposed to corrosive media too numerous to be mentioned individually, including many of the most commonly encountered acids and corrosive salts There is also large employment for these steels for decorative purposes where high polish is required For other applications, further and more special types of corrosion-resisting steels have been developed

One of these, for example, is useful in the sulphate house of coal and coke by-product recovery plants, owing to its resistance to dilute sulphuric acid Also it finds many applications in sugar refineries owing to its resistance to acid calcium phosphate and other chemicals employed , and it is specially valuable in food industries, being unaffected by the dilute solutions of phosphoric acid contained in chemical foods

In a very different field, the use of a corrosion-resisting special steel for the reinforcements of the masonry in the preservation of St Paul's Cathedral, London, suggests that such material will be employed to an increasing extent, ensuring the permanence of our historic buildings as necessity arises It will doubtless be a satisfaction to all concerned with the metallurgy of iron that the special steels so employed and supplied by three Sheffield firms are associated in such an important capacity with the safety of the cathedral in which the Royal Silver Jubilee Thanksgiving Service is to be held

In the construction of new buildings also, high tensile non-corrodible steel is being used, as in the case of certain structural members in the new library of the University of Cambridge

HEAT-RESISTING STEELS

Almost contemporary with the development of corrosion-resisting steels has been the recognition and utilisation of the merits of heat-resisting steels There are, in general, ferrous alloys with high nickel and chromium contents, variable in amount according to the properties required in the products In some cases, the iron content barely exceeds 50 per cent

The term 'heat-resisting', as applied to steels, implies resistance to oxidation and other forms of corrosion at high temperatures, while retaining a high degree of mechanical strength Materials fulfilling these conditions find many important applications, including the valves of internal combustion engines, rotors of gas turbines, mechanical parts of furnaces of all kinds, reaction vessels for coal-hydrogenation, and many other uses requiring mechanical reliability combined with freedom from oxidation and scaling. Developments in this field have been so numerous that it is impossible here to do more than indicate their variety and importance The following examples are, therefore, to be taken merely as representative and by no means exhaustive

Cast iron parts formerly used in mechanical stokers in the Canadian Pacific Steamship Company's vessels of the *Beaver* class, operating with air preheated to 310° F , were found to require replacement after every second round trip The parts exposed to the severest conditions, such as tuyères, grate plates, slicing bars and extension plates, were, therefore, made of heat-resisting steel, and the grates were then found to be in perfect condition after a year's continuous service Similar examples are provided in many other directions and, to take one at the other end of the scale, claw bars of heat-resisting steel in a certain type of domestic hot-water boiler are still in perfect condition after two years service, where new cast iron bars were formerly required every three or four months This is only one of many instances

The exhaust valves of internal combustion engines are, specially where high efficiency is aimed for, exposed to most difficult conditions as regards temperature, mechanical stress and liability to scaling and erosion Here again, special heat-resisting steels come to the rescue, and exhaust valves of such material have contributed to successive world speed records on land, water and in the air Similar conditions apply in the case of the rotors of exhaust gas turbines, in which applications equal success has been attained

For the vessels used in modern high-pressure high-temperature chemical processes, heat-resisting qualities must be combined with resistance to chemical action, and here again the conditions are being successfully met

The applications of these new alloy steels are, in fact, so numerous and important that they will probably have as important an influence on the progress of engineering and the economics of industry as that exerted by the earlier alloys, manganese steel and silicon steel, in their particular spheres

SPECIAL STEELS FOR ARMOUR AND ORDNANCE

Without ceasing for a moment to regret the waste and folly of war, it is impossible to ignore the important contributions to national defence resulting from the applications of special steels in armour, projectiles and other munitions during the War. Then, and, in fact, throughout the particular period under review, the rivalry between armour and projectile continued with steady improvement in each. However, the reference made here to this subject can only be brief, though without doubt our nation must continue to supplement its work by continued efforts if national security is to be preserved.

One of the most striking applications of alloy steel in the War, and one to which it is very appropriate to make present reference owing to its humanitarian aspect, was the use of manganese steel for the helmets of our soldiers and most of our allies. Though commonly known as 'tin hats', these helmets were of the much sterner material known universally as the Hadfield manganese steel, and there can be no question that very large numbers of our brave soldiers owed their lives to the remarkable toughness and resistance to shrapnel fire of this extraordinary material with its non-magnetic qualities most useful in many cases.

SPECIAL STEELS FOR OTHER PURPOSES

At least a passing reference must also be made to high tenacity steels, large steel forgings of extraordinary weight and size, special steels for steam turbines and steam fittings, high-speed tool steels, in which great advances have been made, special magnetic steels and alloy steels for general engineering and constructional purposes. Nor should it be forgotten that there have been important advances in the quality of carbon steels, which are strictly speaking alloy steels, for, of all the elements alloyed with iron, carbon is in many respects the most powerful and remarkable in its effects.

Alloy steels possessing high breaking strengths up to 100 tons per sq. in. and above have been used by engineers for some time past, and there has been steady progress during recent years in the improvement of the quality of such high-tenacity alloy steels, specially as regards toughness and resistance to shock and vibration.

In many of the largest steam turbines on land and sea, and even in more ordinary installations where there may seem to be no special liability to erosion and corrosion, a special alloy of iron high in its nickel and chromium contents is used for the blading, with great advantage in the maintenance of high steam economy, this alloy being highly resistant to erosion and completely non-corrodible under all the conditions experienced by steam turbine blading. For example, already turbines of no less than 7 million horse power in total capacity are now bladed in whole or in part with such special steel.

One of the most interesting developments in modern high-speed tool steels, specially in view of the fact that manganese steel was formerly considered to be practically unmachinable, is the discovery of alloy steels which will drill and cut water-toughened manganese steel, thus making possible a further extension in the many applications of this exceedingly useful material.

Great progress has been made in special steels for permanent magnets and in steels of very high permeability at low inductions; also in new non-magnetic alloys of iron. Again, there have been important developments in the use of alloy steels for general constructional purposes, for example in the hulls of large vessels where reduction of weight is an important consideration. Many other instances might be mentioned, if space permitted, of improvements in alloy steels which have greatly advanced engineering and industrial practice since the year 1910.

IMPORTANCE OF RESEARCH

If there is one outstanding lesson that has been brought out by metallurgical progress in general and made possible the rise of alloy steels in particular, it is the importance of continual research. Also this research, specially where alloy steels are concerned, must be over as wide a field as possible.

As an instance it may be mentioned that the laboratories of the author's firm, as well as those of most modern steel works, have for many years used for routine testing as well as original investigations, equipment for every kind of test—chemical, mechanical and physical—with special apparatus for carrying out tensile, bending, endurance, impact, hardness, electrical conductivity, magnetic permeability, hysteresis, measurement of temperatures from the lowest to the highest, the determination of thermal change points and other tests. In a single week as many as 12,000 pyrometric observations have been made, and equipment for the microscopic examination and photomicrography of steels at all powers up to 5,000 and even 8,000 diameters is continually in use.

In any appreciation of the great and increasing importance of metallurgical research during the past twenty-five years account must be taken of the part played by our universities in the training of metallurgical students, and in many instances conducting valuable research investigations. The special duties and responsibilities of the research laboratories maintained by firms, and working in direct touch with the conditions and requirements of commercial development, can never be fully undertaken by other institutions or organisations At the same time, metallurgists owe a great debt of gratitude to the universities As an example, it may be mentioned that the training and research work carried out in the laboratories of the Applied Science Department of the University of Sheffield are worthy of the highest traditions of the city, and the establishment of metallurgy as an independent faculty with, quite recently, a special founding course and degrees in foundry science is but one instance of the way in which the authorities are keeping in the forefront of metallurgical progress The importance of research facilities is equally recognised at other universities, each in its own sphere, but in regard to ferrous metallurgy the University of Sheffield naturally occupies a special position and is second to none in the world

Outside the many and valuable researches carried out at the various universities of Great Britain reference must certainly be made to the important work being carried on continuously by the National Physical Laboratory, originally under the able guidance of Sir Richard Glazebrook, and now that of Sir Joseph Petavel, to whom and his staff, composed of men of scientific eminence, great credit is due This great national establishment is now supported by large annual grants, aided by Parliament through the Royal Society and the Department of Scientific and Industrial Research

THE FUTURE

Finally, as will have been gathered in the reading of this article, the continued and increasing use of alloy steels in their many forms is most certainly assured The great value of such products can almost be said to be beyond computation in view of the services they render, and modern civilisation could not be sustained by any other means , they may, therefore, be justly said to be beyond any adequate expression in terms of money

It is scarcely realised how largely further advances of present modern civilisation depend upon alloy steels Take these away and our modern civilisation could certainly not exist, at any rate, on anything like its present high plane, and we should in many respects be cast back to the comparatively unsatisfactory conditions of more than a century ago

It is entirely the production and use of alloy steels which have rendered practicable the bringing into being of engineering and other constructions which would not otherwise have been possible, whether in their employment on land or sea or in the air

One useful alloy after another, new or improved, takes its place in the civilisation which it advances and thereafter it is indispensable unless indeed a still better material can be discovered Progress far beyond the bounds which could be foreseen twenty-five years ago has already been achieved, and the rate of such advance appears likely to continue undiminished Therein lie challenge, inspiration and encouragement for those of the younger generation

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Progress in Radio Communication

By PROF. E V. APPLETON, F R S , Wheatstone Professor of Physics, King's College, London

IT is a matter worthy of note that the remarkable progress of radio communication during the last quarter of a century has proceeded largely from the exploitation of the properties of that late-nineteenth century discovery, the free electron. For it is no exaggeration to say that practically all the instrumental progress of the period is connected in some way with that wonderful device, the three-electrode electron tube, while we now realise that the spectacular annihilation of distances in round-the-world communication by wireless is only brought about by the beneficent influence of free electrons at high atmospheric levels. Another significant feature of the period is that radio developments have had an unusually marked influence on human intercourse for, through broadcasting, there has been introduced a new and permanent feature of social and cultural enlightenment while, by way of the oversea wireless telephone, the different parts of the Empire have been brought into a closer unity which from time to time has been sealed by personal messages of greeting from His Majesty the King to all his subjects throughout the world

In 1910 the utility of wireless communication was regarded as being largely concerned with increasing the safety of life at sea. Public interest was, in 1912 for example, stirred by the case of the *Titanic* which, with some 3,000 people on board, struck an iceberg on her maiden voyage

across the Atlantic Several ships picked up her wireless distress signals and raced to the rescue Unfortunately, the *Titanic* had sunk when help arrived, and only 900 persons were saved, though it is clear that without the aid of wireless all would have been lost The first of a series of international conferences concerning the safety of life at sea was held in the following year, though it was not until after the War that stringent regulations concerning the provision of wireless equipment for ships of above a specified tonnage were put into force

Technicians were, at first, slow to recognise the potentialities of the instrument which was to revolutionise the subject, for it was not until 1913 that Armstrong, Meissner and Round independently discovered that the three-electrode valve, which de Forest had invented so far back as 1907, was capable of generating continuous electrical oscillations, and not until after the War was general use made of it in wireless telephony Rather was attention being paid at that time to the possibilities of the Poulsen arc, and the different types of alternators designed by Goldschmidt, Alexanderson and others The general tendency before the War was, in fact, to use arcs and alternators for high-power sending stations and spark generators for short-distance communication between ships

Meanwhile, the fuller utilisation of the three-electrode valve in reception (for detection and amplification) was limited by its inconstancy in operation, which was due to the imperfect vacuum then realisable A notable improvement was effected in this direction by Langmuir who, in 1915, produced 'hard' valves from which all deleterious traces of gas had been removed It thus came about that after the War there was to the hand of the experimenter a device, constant and reliable in operation, which, for sending, would produce sustained waves over a very wide range of lengths, and, on the receiving side, give, in cascade, magnifications of a million-fold. With such a generator, any form of information, whether concerning a sound or a picture, could be transmitted over a distance in the form of a modulation of the waves; while with such an amplifier in use at the receiving end of a wireless circuit, the power required at the sender could be correspondingly reduced.

In the summer of 1922 some of the leading British manufacturers of wireless apparatus approached the Post Office for permission to begin an experimental service of broadcasting speech and music by wireless telephony in this country, and the result was the formation of the British Broadcasting Company. Under the direction of this Company and its successor, the British Broadcasting Corporation, which on January 1, 1927, was incorporated by Royal Charter, there has grown up a great service of sound broadcasting in Great Britain, while to provide listeners with the necessary apparatus for reception there has arisen a new and vigorous electrical industry In the evolution of the modern wireless receiver, commercial research has led to the development of new types of valve filaments giving greater efficiency and to more elaborate types of electrode structures In this connexion special mention must be made of the immediate derivatives of the three-electrode valve, namely, the screen-grid valve for high-frequency amplification and the pentode for distortionless amplification of strong signals

Most histories contain a revolution, and the history of wireless communication is no exception to the general rule At the end of the War, it was regarded as established that long waves were superior to short waves for long-distance communications. The superiority was, in fact, embodied in a transmission formula due to Austin, which was then much employed by radio engineers It is generally thought that the first hint of the extraordinary possibilities of short waves for long-distance communication came from the experiments of amateurs in December 1921 Such experimenters were limited by law to use wave-lengths less than 200 metres but, though operating with very small power indeed, they were able to establish contact with other amateurs 7,000 miles away. During the winter of 1922–23, Dr W H Eccles and H Morris-Airby, using receivers tuned to wave-lengths lower than 100 metres, were able almost every night to pick up signals from American amateur stations, often as harmonics of the sending wave-length. In October 1924 the greatest distance of all was spanned when communication was established between F. Bell in New Zealand and C. W Goyder, a Mill Hill schoolboy.

The revolution mentioned above came at a time when the problem of linking up the Empire by wireless was under discussion In March 1923 the British Government announced the decision to erect a large wireless station at Rugby, capable of communicating with any part of the world. By the end of 1926 this station, working on long waves, as well as a wireless telephone long-wave link between Great Britain and North America, were in successful operation. The latter service, the details of which were worked out by the engineers of the British Post Office in collaboration with the engineers of the American Telegraph and Telephone Company, was the first long-distance commercial wireless-telephone link to be completed, and its inauguration constitutes a landmark in the history of electrical communication In connexion with Empire telegraph communications by short waves the engineers of the Marconi Company did pioneer work The most notable invention in this field is due to C S Franklin who showed how, by using a special array of aerial wires with a similar array behind, to act as a reflector, it was possible to confine the waves into a directed beam Nowadays, for all point-to-point services, advantage is taken of such directional and economic projection of the waves

To the short wave beam station built by the Marconi Company for telegraph communication to the Dominions, there have been added direct wireless telephone services to different parts of the Empire In these cases also beam senders and receivers, built by the Post Office, are used, with corresponding stations oversea The sending stations are all accommodated at Rugby, while the corresponding receiving stations are situated at Baldock The result of these direct Empire services is that it is not an exaggeration to say that the whole of the Empire is 'on the telephone', with London as the exchange A further experiment in Imperial communication has been the inauguration of Empire short-wave broadcasting by the B B C in 1932 At first it was attempted to provide a two-hours' programme in each of five Empire zones between the convenient hours of 6 p m and midnight, local time, while the B B C publication, *World Radio*, which is the official organ of Empire broadcasting, is published so far in advance that copies of it are available in different parts of the Empire at the appropriate time

On the more purely scientific side, substantial progress has been made during the last twenty-five years, especially as regards the elucidation of electric wave propagation For the propagation of waves along the ground the correctness of the transmission formula of Sommerfeld has been checked by signal intensity measurements made by Barnett and Ratcliffe and by B B C engineers Other quantitative experiments have been carried out to elucidate the structure and properties of the highly ionised region of the upper atmosphere (from 100 km upwards) known as the ionosphere, which reflects wireless waves and makes long-distance radio communication possible The existence of such a reflecting stratum was postulated so far back as 1905 by both Kennelly and Heaviside, but it was not until 1924 that its situation in the atmosphere was established Further investigations have shown that above the Kennelly-Heaviside layer, as the region about 100 km is called, there is a more intensely ionised stratum, the electrical density of which is the factor that limits the shortest wave-length which can be used for round-the-world communication Experiments carried out by Henderson, Rose and others during the solar eclipse of 1932 in Canada have shown that the upper atmospheric ionisation is caused by the photo-electric action of sunlight Due to the influence of the earth's magnetic field on the motion of the free electrons, the ionosphere is a doubly-refracting medium and resolves an incident wireless wave into two oppositely rotating components which experience absorption of different amounts The result is that a reflected wireless wave of, say, 400 metres, is of predominantly left-handed polarisation in the northern hemisphere but of opposite rotation in the southern hemisphere

The ionisation in the upper atmosphere is not by any means constant It is usually denser by day than by night and denser in summer than in winter, but these normal variations are sometimes profoundly upset by manifestations of solar activity The general effect of such activity has been found to be an alteration of the disposition of the electrification and thus of the properties of the ionosphere as a reflecting medium One of the curious things noticed, in our latitudes, is the difference in the effects on long-wave and on short-wave transmission With long waves a solar disturbance which produces a magnetic storm may often increase the daylight signal intensity, but in the case of short wave channels there is almost always a sharp reduction in signal strength In the case of communication over a great circle which traverses high latitudes, the effects of a magnetic storm have been found to be specially marked, which explains why the short wave channels to Canada are more frequently interrupted in this way than are the services to South Africa

On the purely technical side there have been, particularly since the War, many notable contributions to electrical circuit practice, quite apart from the thermionic valve and its derivatives Selection is difficult, but perhaps the superheterodyne circuit of Armstrong and the quartz crystal oscillator of Cady may be chosen as outstanding. The superheterodyne receiver, in which amplification is effected after the conversion of the received signals to a lower frequency, is almost universally used nowadays in commercial practice and in the more elaborate broadcast receivers, while the quartz oscillator, particularly in the hands of Dye and his associates at the National Physical Laboratory, has been developed to provide high-frequency standards of a constancy and accuracy hitherto unattainable.

The Perfection of the Thermionic Valve

By B S. GOSSLING, Research Laboratories, General Electric Co , Ltd , Wembley

THE past twenty-five years have seen the coming of a great change, both in human society and in the individual human life Man has become able to speak to man, and man to mankind, directly and without obstacle of distance Next week, King George will speak, not for the first time, to all his people wherever they may be, and his hearers may well ponder this new aspect of the many-sided relation between Crown and people

For the ordinary man the change is that he is now in ready touch with his fellows, whether actively and personally through the long-distance telephone, or passively and with others through broadcasting As His Majesty has implied in his broadcast words, this means that the tragedies of enforced loneliness and anxiety will soon be erased from the lot of man Music is now within reach of all who will, and whatever there be between learning and laughter that the spoken word can bring to our ears

The principal instrument that has enlarged on this vast scale, and yet without artificiality, the scope of our most natural mode of communication —by voice and ear—is the thermionic valve The attainment by this instrument of its present large measure of perfection—so much even those who best know its faults can allow it—falls easily within the period under review, but springs from the efforts of so many workers in so many countries that it can here be presented only in the briefest of outlines

To begin with, making our start from somewhat less than thirty years ago, there were then two well-recognised and eagerly pursued problems in the art of communication The first quarry in the hunt was a delicate device capable of controlling energy from a local source in faithful response to an incoming signal, such as the attenuated speech-waves on a telephone line the length of which it was desired to extend, or alternatively a weak wireless signal The second aim was a means of generating continuous high-frequency oscillations adaptable to similar faithful control by a microphone for wireless telephony. It was already realised that whatever should solve the first of these would also, when allowed to react on itself, go a long way towards solving the second. There was also in existence a device, the simplest, or diode, form of thermionic valve, in which current passed between electrodes in an evacuated glass bulb ; this offered a means of detecting high-frequency signals by regular rectification, but it was biding its time in face of other temporarily approved alternatives

Ideas had arisen too, in more minds than one, of making such devices more responsive to an incoming signal, but these ideas were as yet vague in the extreme

To complete this outline of the conditions of incubation of the valve as we now know it, we should note the technical position at the time. Amongst makers of electric lamps the production of high vacua in glass vessels, already well advanced as an art in daily practice, was being raised to the higher pitch demanded by the tungsten filament, and was ahead of corresponding practice in the laboratory in some respects at least Acquaintance with pumps in great variety, and the use of many of them, the choice of suitable glass, its fabrication in conjunction with small metal parts, the method of outgassing by 'baking' under vacuum, the use of phosphorus as 'getter' for improvement and maintenance of vacuum, the choice again of suitable metals in addition to tungsten, all these alike were well understood, so that when the need came, any well-equipped lamp works could launch out into valve-making

About the opening of our period, valves, thus incubated, hatched out in various places, and the excitement attending the demonstration of their working was proportionate to the interest of the double problem which they solved A clear explanation of what was going on in them did not, however, come at once The little that was known was reflected in their construction The addition of the third or intermediate electrode left a controlled stream of moving particles as the obvious main connexion between input and the output circuits, but much time was spent, by some at least, before the essential simplicity of the valve and the comparative unimportance of the differences between early types were realised. It is interesting that, before these fascinating devices were turned into reliable tools, a blind eye had to be turned on those factors which need not be taken into account in explaining their action The first of these inessentials was gas ionisation , it had to be realised that, since even the simple diode would work at voltages below the ionisation point, some other agency must be sought. Once this was appreciated a newly-fledged graduate in physics could acquire sound ideas of the main current-voltage relation by working out the solution of a

Poisson's 'space-charge' equation Given this luxuriously simple basis, or even still simpler qualitative ideas on the same lines, the other less important factors could be viewed in proper perspective, and the inherent limitations of the valve could be defined, even thus early, in terms of natural constants In the triode, again, the main point to be appreciated was that one was not required to trace out the motions of particles in transit through the intermediate grid, but only to regard this member as behaving chiefly as a somewhat leaky Faraday screening cage which defined for the region near the cathode a residual field controlling the strength of the current of escaping electrons The German term *Durchgriff* survives as a happy illustration of this point

So much for the valve itself Its action in the circuit had to be deduced by the application of alternating current theory to the relative variations of the voltages applied to the various electrodes and the currents led to or from them Here, contrariwise, the range of relevant premises had to be enlarged by including the displacement currents in minute and at first disregarded stray capacities before laborious algebra bore full fruit in explaining the observed phenomena of amplification and spontaneous oscillation From this work arose, as a kind of shorthand, the array of technical terms such as 'amplification constant' (as compared with its reciprocal synonym *Durchgriff*), 'anode impedance', 'reaction' and so forth now heard out of the mouths of schoolboys

All this work was spread out, with much duplication and overlapping, over the first quarter of the period The effect of the War, sometimes spoken of as a time of great advance, is dubious. It seems in retrospect that intrinsic development may actually have been retarded by the isolation and distraction of those who would in any event have carried on that work The real benefits of this period were indirect; improvement of technique was stimulated by the making of large numbers of valves, and the number of those conversant with the use of them increased with abnormal rapidity After the War, however, the expansion thus made possible did not come at once The valve as a perfected tool had to establish its position, and that on a world-wide scale, by the resumption of the normal exchanges of scientific and technical intercourse, and by further demonstrations arising from free experimental activity In regions outside the United States, preparations had to be made for the insertion of valve amplifiers or 'repeaters' in telephone lines, and over the oceans the extension of direct wireless telegraphy and the introduction of telephony had to be arranged.

It was, then, at about the middle of our period that the valve came into its own For the specialised conditions of long-distance telephony on land-lines the necessary requirement of reliability was early satisfied In wireless the word 'system' dropped out of common parlance, the time for alternative methods was past The discovery of the peculiar transmission possibilities of 'short' waves, for the generation of which valves were uniquely adaptable, brought world-wide range almost as a gift At the same time came broadcasting, with, on the technical side, the need of new standards of faithfulness imposed by the nature of the matter transmitted, particularly music, and of reliability at both ends of the unilateral transmission The waste of energy by thermal radiation from the cathode was progressively reduced The implicit possibility of using free electronic projectiles as the sole connexion between circuit elements was exploited in 'screen-grid' tetrodes and later more complicated types Amplification was carried to the limit set by those disturbances, the 'Shot effect' and the like, arising from the discontinuous structure of matter itself, a real limitation at present The power handled by valves has, however, since the conversion of the anode into a water-cooled metal portion of the envelope, no near upper limit, even without resort to continuous evacuation Uses have also at length been found for thermionic devices employing ionisation in the forms of heavy-current rectifiers of great efficiency, occupying a position midway between the high-vacuum rectifier and the rectifying arc, and of trigger devices which make a virtue of the formerly troublesome discontinuity in current-control in presence of a lavish supply of ionisable material

In the field of communication, the second half of our period has thus been a time of technical consolidation and expansion and of the rise of great social implications During this time also the valve has influenced the course of scientific research as an instrument generally adaptable for use wherever there is a need for delicacy and nimbleness beyond what is conveniently possible for purely mechanical devices Thus, physiologists have been using valve amplifiers for the study of nerve action as revealed by minute electrical changes, valves, sometimes of special design, have replaced sensitive voltmeters and electrometers, thermionic relays have come into use for counting the minute discontinuous occurrences of atomic disintegration, metallurgists have used valve-generated high-frequency currents in furnaces for melting experimental specimens

The position at the present day and the immediate prospect have now to be outlined One point of arrest is to be noted The deliberate design of valves by calculation has progressed but little, although the physical principles being known this work might be held to have passed into the province of the engineer. However, the mathematical functions are generally intractable, and engineers may be excused for their reliance on methods of trial and error. As valves get larger, however, such methods are becoming expensive. The evolution of the valve is not yet by any means complete, although sometimes, as in television, the valve is an accepted tool and interest centres on other devices at either end of the train of valves.

There is still, however, the new field where the periods of electrical oscillation are so short that electron inertia is no longer negligible, but has itself to be brought into service as a main principle of action. Here early history has been repeating itself, but the period of groping is now past; theoretical study is difficult but is well advanced. Indeed, in contrast to the early days, development has been somewhat in advance of demand. There are also novel devices using free electrons which are not of thermionic origin but are ingeniously obtained by photo-electric or secondary emission.

Other new developments may be expected now that valves have made their appearance in the laboratory as appliances built and operated by continuous evacuation in the laboratory for the purposes of research without recourse to the valve maker, for example, for obtaining continuous high-voltage supplies by rectification and very recently also by short-wave oscillation. It is not in general to be supposed that valves manufactured by the thousand for engineering purposes or by the million for domestic use are really those best suited for special problems, and it is well that the experimental physicist should take the initiative in meeting his own needs.

Finally, new prospects are beginning to open in yet other directions associated rather with the material needs of the human body than with man as an intelligent and social being. For some few years high-frequency electrical oscillations of wave-lengths from a few metres downwards generated by valves have been coming into use for purposes as yet perhaps of practical medicine rather than of physiological study, first for surgery, and later for the reinforcement of the *vis medicatrix naturæ*, in part, it would seem, by some kind of inward fomentation, and in part, perhaps, by some more specific action dependent on the existence of natural frequencies in molecules of various sizes or in small bodies of greater than molecular size. The achievement of direct specific action on such structural elements would open up wide fields of application to chemical and biological processes far removed from the problems of communication from which the development of the essential instrument took its origin.

Developments in Aeronautical Science

By PROF. F. T. HILL, Assistant Professor of Aeronautics, Imperial College of Science and Technology, London

THERE can be few applied sciences able to compare with aviation in the rate at which purely academic physical conceptions have been first translated into actual accomplishments and then industrialised, to the extent of the aircraft industry in the short space of a quarter of a century. Although the mechanics of flight have been investigated by certain mathematicians practically since the Middle Ages, continuous sustained flight for heavier-than-air machines, or even a useful degree of controlled flight in lighter-than-air craft, was not possible until some device capable of giving out power in the form of a propeller thrust was available, with reasonable weight. The internal combustion engine made this possible, and in 1903 the first power-driven flight in a heavier-than-air machine was made by one of the Wright brothers in the United States. The dirigible balloon antedated this achievement by a few years for lighter-than-air craft, although it is not possible to be precise about the date of the first flight owing to the difficulty of specifying exactly what constituted a power-driven flight, as distinct from having merely floated from one spot to another. It is certain, however, that at the commencement of the period under review, achievement in either school did not consist of much more than having succeeded in flying for a reasonable period of time, with a very small margin of safety. Little attention had been paid to progress towards any severely utilitarian aspects of the problem of flight.

In the spring of 1910, Cody, Dunne, Roe and Short were flying aeroplanes of their own design and building in Great Britain. Mr. J. T. C. Moore-Brabazon (now Lieut.-Col. and at present president of the Royal Aeronautical Society) was granted the R Ae C Club pilot's certificate number one, for making the first officially observed flight in the British Isles, under certain specified conditions The power used varied from a 50 horse-power Antoinette in Cody's machine to a 9 horse-power J A P engine used by Roe Speeds appear to have been about 50–55 miles per hour, and somewhat uncertain, but Cody held one definite record then of having remained in the air for a little more than one hour.

With lighter-than-air craft, the pressure type of envelope was in use then. This was either non-rigid, using the gas pressure to maintain its elongated form, or semi-rigid, with the shaped balloons partly stabilised and supported by a longitudinal framework Airship activity in Britain was almost entirely confined to the British Army Balloon Factory at Farnborough A few small airships were built by Messrs Willows and Co. during the years 1905–12, an outstanding feature of these being the introduction of swivelling propellers as an auxiliary to the normal controlling surfaces, a device still often used on modern airships The Army airships of early 1910 were capable of about 35 miles per hour speed, with a 35 horse-power Green engine, and carried a crew of three

The period 1910–18 can logically be considered to be one of the development of war machines Previous to 1914, the production of machines directed towards a military outlook was stimulated by a War Office competition held in the summer of 1912, and as no equal incentive towards any form of civil aviation existed, the military requirements predominated in design then The year 1912 thus crystallised the attainments of the machines of that day in the military competition, and helped to give definite ideas upon possible lines of improvement A top speed of 75 miles per hour, a lowest speed of 50 miles per hour necessarily accompanying it, a rate of climb of about 400 ft per minute, and a ratio of descent to forward travel with the engine stopped (gliding angle) of 1 in 8, can be taken to be the best performances then Military requirements demanded increase in top speed and climb for fighting purposes, an increased gliding angle for enlarging the area over which the pilot could land in the event of engine failure, and a reduction, if possible, in the already dangerously high landing speed. The development during the whole War period can be summed up by saying that the required improved performances were obtained by the use of greater and greater powers, as these became available from contemporary improvement in the internal combustion engine designed specifically for aircraft work By 1918 these average values (excluding a few freaks for special purposes) can be said to have reached 130 miles per hour for top speed without any corresponding increase in landing speed, 2,000 ft per minute for initial rate of climb, and a gliding angle, although varying considerably with the type of machine, greater than 1 in 8 Size had also increased from a two-seater, say, 500 lb total useful load, to one carrying a load of about 9,000 lb

During this same period the most marked advance in the lighter-than-air craft was that of size, which brought about the necessity for a different construction, the 'Rigid' or Zeppelin type In this a number of separate gas bags are encased in a rigid framework of elongaged cylindrical form, the whole of the load being taken by this structure This construction is used for all large airships to-day The smaller airships were by no means superseded, but they made no great strides in development, being suited to the naval and military duties allotted to them without any drastic alterations By 1918, British rigid airships had reached a speed of 70 miles per hour, carried 1,250 h p in power, with a disposable load of about 27 tons The most outstanding point in performance, in which the airship is still ahead of the aeroplane, was its range At a reduced speed of 45 miles per hour, the rigid airship of that day had a cruising range extending over nearly nine days

The reconstruction period in 1919 allowed attention to be paid to the more scientific side of aircraft design, when the immediate urgency of increased performance at all costs was removed The study of aerodynamic theory produced rules for design resulting in less resistance to motion, both from drag and interference, the net result of which was either increase of speed, greater carrying capacity or wider range, for a given engine-power output Progress in engine development itself gave that power with less engine weight, smaller fuel consumption, and reduced drag for cooling purposes, and concurrently engines of greater power were produced A better understanding of the problem of aerodynamics and theory of structures, added to the increased engine-powers available, led heavier-than-air craft design into specialised channels, and types tended to become, and have remained, with different characteristics depending upon their design criterion To-day the records stand at 440·67 miles per hour maximum speed, 5,654 miles non-stop distance, and more than 57,000 lb useful load carried In none of these cases are such machines of any general use, but the figures indicate the magnitude of the progress made during the post-War period A fair estimate of how far practical requirements modify these figures is obtained if the results of the England-

Australia race of October 1934 are taken This was won by a De Havilland Comet which, although built specially for the race, is of a type that could be used for ordinary everyday commercial flights The flight to Australia, a distance of 11,300 miles, occupied 60 hours 50 minutes flying time, an average not far short of 200 miles per hour Certain military types have normal speeds somewhat higher than this

That such progress should have been made without setbacks is scarcely to be expected, and it is almost paradoxical that such failures, resulting in a train of investigations into their causes, have probably been the greatest help to ultimate success The investigation of accidents and the subsequent building up of design laws that shall avoid a repetition of them, has been one of the responsibilities of the Aeronautical Research Committee in Great Britain throughout the whole of the period under review For example, the gradual increase in speed has produced aerodynamic forces on the wings the precise extent of which had not been anticipated from the experience available at lower speed flight The current theory of structural design was not always adequate to deal with such cases, and wings and control surfaces, lacking stiffness, have developed 'flutter' which has sometimes led to the collapse of the structure of the aircraft It can be safely said that to-day the scientific aspect of this question has now been worked out

Another similar outstanding scientific development is that of landing a machine with maximum safety As the top speed of flight began to increase, it became necessary to investigate the aerodynamics of increasing the speed range, otherwise the landing speed became dangerously high. Even with this as low as possible, pilots are tempted into approaching too near it, and with no margin in hand, they allow the machine's speed to fall below the minimum, and 'stall', usually with serious results This problem has been defeated in two distinct ways the use of aerodynamical devices that delay the occurrence of the 'stall' to a slower speed, or giving the pilot that extra control over the orientation of the machine by which he can neutralise the most dangerous result of a 'stall', the loss of his normal control actions A combination of these two ideas to-day can make the actual flying of a machine as nearly 'foolproof' as can ever be needed One attempt at dealing with this question has resulted in the creating of a novel type of aircraft—the autogiro. The supporting wings of this machine are rotated in a horizontal plane, windmill fashion, instead of being fixed to the body, as in the normal form of aeroplane Thus, their lift, which supports the machine, depends primarily upon their speed of rotation and not upon the forward speed of the craft This latter may be reduced very greatly by the pilot, but as long as the wings are kept rotating above the minimum speed necessary, the machine will retain its full support

The post-War history of lighter-than-air craft is unfortunately not so happy a tale The rigid airship has grown in size, and has been developed towards the idea of a long-distance transport machine A new German Zeppelin, just about to be launched, will carry eighty-five passengers, ten tons of freight, in addition to accommodation almost comparable with an Atlantic liner Its engines total 5,000 horse-power, and its range without refuelling will be about 10,000 miles This ship, together with a somewhat smaller sister, the *Graf Zeppelin*, now flying regularly, will be the only large rigid airships in commission in the world The generally accepted principle of any vessel that obtains its lift from buoyancy—that its efficiency as a load carrier increases with its dimensions—means that the accompanying increase in cost makes the experiments more susceptible to the difficulties of replacement in the case of failures. Both Great Britain and the United States have discontinued experiments upon large rigids, largely because of the political aspect that has arisen as the result of accidents costly both in lives and material

To sum up the situation to-day, after twenty-five years development, in heavier-than-air craft any speeds, up to those that the ordinary human being can stand without special training, can be flown, provided that the price in power required for it can be paid This price will probably be reduced gradually as more efficient machines are produced, but there does not appear to be any very revolutionary change in sight Sizes of machines such as will give a reasonable degree of comfort are already in existence, and will probably increase, although in theory there should be a limit to this, as the ratio of the structural weight of the machine to the total flying weight must increase This limitation is not serious so long as the size necessary for comfort has been attained. In range it is still uncertain as to whether the direct route across the Atlantic and Pacific Oceans can be flown under unfavourable conditions, at least as an economic proposition Except for these two cases, the range of any normal aeroplane can be such that it is well within reach of organised aerodromes all over the civilised world. In this last case lies the principal hope for the future of the large airship. Its capacity is such that the longest possible journey necessary, that is, half-way round the earth, is probably within its attainments even to-day.

Progress in Turbine Machinery

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

IN March 1776 in the reign of George III, Johnson and Boswell spent a few days in Birmingham, and the latter, accompanied by Johnson's old schoolfellow Hector, took the opportunity to see the famous Soho Manufactory of Boulton and Watt. During Boswell's tour through the shops where parts of the engines of Watt were being constructed, Boulton with pardonable pride remarked to him: "Here, Sir, I sell what all the world desires to have—Power". Only half a century had passed since Newcomen, in the reign of George I, by the invention of the atmospheric pumping engine, had ushered in the age of steam power, but already steam engines were being erected in mines, factories, breweries and works on an increasing scale, and five years later Boulton wrote to Watt, "The people of London, Manchester and Birmingham are steam-mill mad". Great pioneers as they were, neither Watt nor Boulton, however, visualised the important part steam was destined to play in industry and transport, or that before the death of George III steam would be applied to ships and locomotives. Year by year the demand for power grew; by 1840 the steam engines of the world were estimated to have an aggregate of more than 2,000,000 horse-power, and a century after Boulton had spoken of London, Manchester and Birmingham as being steam-mill mad, the total horse power of stationary and marine steam engines and steam locomotives in the world was estimated at about 30,000,000.

However remarkable these figures may appear, they are comparatively insignificant when placed beside those of the world's power plants to-day. With the passage of time have come improvements in hydraulic turbines, the introduction of oil, gas and spirit engines, the invention of steam turbines and also the construction of power-driven electric generators from which electricity for power purposes can be transmitted over long distances. Any review of the mechanical progress of the reign of H.M. King George V must therefore necessarily have as its central feature the development of prime movers and electric generators. Of the prime movers, the reciprocating steam engine is still the most important unit on our railways, the petrol engine is practically without a rival on the roads and in the air, the oil engine has spread all over the world and has successfully challenged the steam engine for certain classes of ships, the hydraulic turbine coupled to electric generators is used where sufficient water power is available, but for the propulsion of fast vessels, such as warships and liners, and for driving electric generators in steam power houses the steam turbine is supreme. About 96 per cent of the electricity generated in Great Britain is produced in steam stations, the majority of which contain turbo-generators. It is acknowledged that the construction of the first turbo-generator by Parsons in 1884 is as great a landmark in engineering history as the invention of the separate condenser by Watt in 1765, but it is only within approximately the last twenty-five or thirty years that the steam turbine has surpassed in size and power the great reciprocating engines which were the direct descendants of the rotative engines of Watt.

When shown at the Inventions Exhibition of 1885, the first turbo-generator of Parsons, with its high speed of rotation (18,000 r.p.m.) and its extravagant steam consumption (129 lb. per kilowatt hour) excited no great interest and raised no great hopes. It contained, however, all the essential elements for success, and ten years later Parsons was building his first 350-kilowatt turbo-generator and also the 2,000 h.p. turbines for the famous *Turbinia*.

Six years later a great advance was made by the construction of the 1,250 kw. machines for the city of Elberfeld in Germany. These machines had a steam consumption of only one seventh that of the original turbo-generator, and their success paved the way for further developments. One of the finest and most efficient machines running at the time of the accession of King George V was a 5,000 kw. turbo-generator at the Carville power station of the Newcastle-upon-Tyne Electric Supply Company. Supplied with steam at a pressure of 200 lb. per sq. in. superheated to 508° F., this machine revolved at 1,200 r.p.m. and had a steam consumption of 13·19 lb. per kwh. The record set up by this machine was surpassed by that of a far larger turbo-generator of 25,000 kw. ordered in 1911 from Messrs. C. A. Parsons and Co., Ltd., for the Fisk Street Station of the Commonwealth Edison Company of Chicago, U.S.A. In this case the speed was 750 r.p.m., the steam pressure 200 lb. per sq. in., the steam temperature 588° F. and the steam consumption 10·42 lb. per kwh. or about one twelfth of the original machine. Ever since then, by improvements in design, the utilisation of many inventions, the employment of superior materials, by increasing steam pressures and temperatures and by many other means, it has been possible to construct turbo-generators still more efficient and of greater and greater capacity, the present limit in size being marked by the 208,000 kw machine of the State Line Power Station, Chicago

In Great Britain, the limit of size is marked by the 105,000 kw turbo-generator now being erected in the Battersea Power Station of the London Power Company by the Metropolitan-Vickers Electrical Co, Ltd The installation of such machines is one of the outcomes of the extended use of electricity for industrial and domestic purposes, brought about partly through the work of the Electricity Commissioners and the Central Electricity Board, which have been responsible for the erection of the National Grid In the latest report of the Central Electricity Board, it is stated that the production of electricity in Great Britain during the past five years has increased by 50 per cent Co-ordination in the electric supply industry, too, has led to the closing down of uneconomical stations and the erection of many new stations, of which Battersea is but one Full descriptions of these stations have appeared from time to time in the technical press and from these have been taken a few particulars of turbo-generators which illustrate current practice In various countries stations have been or are being erected, with steam pressures far in excess of those mentioned below, but these stations are comparatively few

It was perhaps but natural, as the Parsons steam turbine was developed on the banks of the Tyne, that some of the most historic turbo-generators should be found in the Newcastle area. Mention has already been made of the Carville station The latest and most up-to-date station in the district is the new Dunston power station of the North-Eastern Electric Supply Company This station has an ultimate capacity of 300,000 kw, but at present it contains three 50,000 kw machines The steam is supplied at 625 lb per sq in and at a temperature of 825° F The turbines are of the two-cylinder tandem type and run at 1,500 r p m Current is generated by the alternators at 13,500 volts and a frequency of 50 cycles An interesting feature is that the steam leaving the high-pressure cylinder is taken at a pressure of 115 lb per sq. in to re-heaters and is then passed to the low-pressure turbine at a temperature of 800° F

One of the most important stations in the Midlands is the Hams Hall station of the Birmingham Corporation, the first part of which was opened by the Duke of York in November 1929 It is designed for an ultimate capacity of 240,000 kw. but there is ample room for its expansion to 1,000,000 kw. if required. Steam is supplied from pulverised-fuel fired boilers at 375 lb. per sq. in. and 710° F. to 30,000 kw turbo-generators running at 1,500 r p.m., generating current at 11,000 volts and a frequency of 25 cycles In the north-west, the Clarence Dock power station of the Liverpool Corporation has the highest thermal efficiency of any station in Great Britain, namely, 26 06 per cent It is unique in being built on the floor of a disused dock Designed for an ultimate capacity of 400,000 kw, with eight 50,000 kw turbo-generators running at 1,500 r p m, it has at present three machines generating current at 7,250 volts and a frequency of 50 cycles The steam pressure is 450 lb per sq in and the steam temperature 750° F The station began work in 1931, and tests of the steam-raising plant showed an efficiency of 86 45 per cent, while the thermal efficiency of the turbines was 30 4 per cent In the construction of the generators, advantage was taken of electric welding By using welded frames for the stators instead of cast frames, no less than 16 tons weight was saved

It would be possible to trace the development of power station practice from the power houses in the London district alone, for it was in Holborn in 1882 that the first central station in the Old World was opened, while at Deptford, Ferranti built what has been called the "forerunner of modern power stations". Several big companies to-day serve the metropolitan district, and the London Power Company has six 'selected' stations for the purposes of the Electricity Act of 1926 Of these, Deptford West took the first place for thermal efficiency among British stations in 1931, while at Battersea is being installed the 105,000 kw turbo-generator referred to above The Battersea station is designed for an ultimate capacity of 400,000–500,000 kw The machines at work at the present time consist of two 69,000 kw three-cylinder turbines driving generators delivering current at 11,000 volts. The boiler pressure is 625 lb per sq in and the highest temperature of the steam is 875°–900° F This station is equipped with an elaborate plant for preventing the emission of sulphurous fumes from the chimneys Lastly, brief mention may be made of the Barking power station of the County of London Electric Supply Co, the first part of which was opened by H M the King ten years ago. The largest set at that time was a 35,000 kw turbo-generator, but the station now possesses two 75,000 kw machines using steam at 625 lb pressure and 825° F temperature In these turbines steam is 'bled' from four different points for the purpose of feed heating. The station has at present a capacity of 390,000 kw.

From the first, the steam turbine had one particular advantage over the reciprocating engine for driving electric generators, inasmuch as it was most efficient at high speeds When, however, it was applied to marine propulsion, owing to the inefficiency of propellers at high speeds, a compromise had to be made. Yet its inherent qualities led the marine steam turbine quickly to surpass the turbo-generator in point of size, and only ten years elapsed between the debut of the *Turbinia* at the Diamond Jubilee review of 1897 and the construction of the 70,000 h p turbines of the *Lusitania* and *Mauretania* and the adoption of steam turbines for all classes of warships except submarines When referring to the steam turbine in his Gray Lecture to the Institution of Mechanical Engineers in 1930, Eng. Vice-Admiral Skelton said : "Its application is one of the few important marine changes which were made without any setback, and the initial success and the rapid extension of the system is undoubtedly attributable to the experience gained in its long and gradual development under proper conditions on shore, no less than to the soundness of the conceptions of the inventor and his thorough exploratory work in connexion with the marine application"

It had been realised quite early that in ships it would be an advantage to have some form of reduction gear between the turbine and the propeller, and the development of steam turbines afloat during the last twenty-five years presents several aspects, first the progress with direct driving turbines, secondly the use of turbines coupled to the propeller shafts with either mechanical, hydraulic or electric transmission gear and thirdly the combined use of reciprocating engines and turbines The most notable direct-driven turbine ships of the last quarter of a century include the *Aquitania* (62,000 h p), *Berengaria* (65,000 h p), *Majestic* (84,000 h p) and the *Leviathan* (82,000 h p) ; and large warships such as the *Iron Duke* (31,000 h p), *Malaya* (75,000 h p) and *Repulse* (112,000 h p) Helical-toothed reduction gear, tried out by Parsons in the *Vespasian* in 1909, was adopted in turbine-driven cross-channel vessels and destroyers in 1911 and quickly came into favour By September 1919 the total horse-power of geared marine turbines completed or under construction was about 18,000,000 The use of gearing enabled the efficiency of both turbines and propellers to be increased, turbines of 20,000 h p with gearing being equal to turbines of 30,000 h p without gearing H M S. *Furious* (90,000 h p), H M S *Hood* (144,000 h p) and H M S *Nelson* (45,000 h p) all have geared turbines, as also have the modern Atlantic liners *Bremen*, *Europa*, *Conte di Savoia* and *Rex*, while the machinery of the *Queen Mary* will be of this type

Hydraulic transmission between the turbine and the propeller has never been extensively used, but electrical transmission, first used on a large scale in the United States Navy, has made rapid strides The French liner *Normandie* is fitted with electric drive, and will have four main turbo-generators of 34,200 kw delivering current to the motors on the propeller shafts, the whole plant rivalling in size and interest the machinery of a big power station

Marine engineering practice has sometimes forged ahead of and sometimes lagged behind land practice, but to-day it tends to run on parallel lines Progress during the last twenty-five years has been due to many eminent engineers, among whom the inventors of steam turbines, such as Parsons, De Laval, Curtis, Zoelly and Rateau, hold the place of honour

News and Views

Prof. P. Kapitza and the U.S.S.R.

It is common knowledge in scientific circles that Prof P Kapitza, director of the Royal Society Mond Laboratory at Cambridge, and Messel professor of the Royal Society, has been detained in Russia since last September by order of the Government of the U.S S.R. Kapitza came to England as a member of a Russian scientific commission in 1921. He soon started to work as a research student at Cambridge under the supervision of Lord Rutherford, and after some preliminary work on radioactivity he commenced work on the production of intense magnetic fields, and in 1925 a new laboratory, financed by the Department of Scientific and Industrial Research, was opened for the work. By the use of a special alternator, Kapitza was able to produce fields up to 300,000 gauss, and to carry out experiments showing the existence of new phenomena in conduction and in magneto-striction. Since most of these phenomena are more pronounced at low temperatures, a hydrogen liquefaction plant was added in 1929, and in 1930 the Royal Society made a special donation of £15,000 to enable a new laboratory to be built to house the original apparatus, together with a helium liquefaction plant. It was characteristic of Kapitza that he was not satisfied to take over existing designs of helium liquefiers, but began immediately to work on the construction of a new type of liquefier which required no liquid hydrogen. This liquefier is an illustration of Kapitza's special technical gift, for it incorporates a piston type engine, which works down to the temperature of liquid helium. This liquefier, which was described in NATURE of May 12, 1934 (p. 708), was perfected last summer, and Kapitza was able to carry out preliminary experiments using strong magnetic fields combined with helium temperatures before leaving for Russia in September to attend the Mendeléeff Congress.

THROUGHOUT these years of developmental work, Kapitza had visited Russia almost every summer. During these visits he gave lectures and advised on the construction of new institutes, and it was known that he had at one time been offered the directorship of an institute in Russia, but Kapitza himself considered that conditions in the U S S R were not favourable for the development of his work It came, therefore, as a shock to his colleagues to learn in October that Kapitza's return passport had been refused, and that he had been ordered to begin the construction of a new laboratory in Russia The reasons underlying this action may be inferred from the following statement from the Soviet Embassy which appeared in the *News-Chronicle* -"Peter Kapitza is a citizen of the U S S R , educated and trained at the expense of his country He was sent to England to continue his studies and research work   Now the time has arrived when the Soviet urgently needs all her scientists So when Prof Kapitza came home last summer he was appointed as director of an important new research station which is being built at Moscow" This commandeering of Kapitza's services on behalf of the U S S R ignores the personal and psychological factors involved, as was pointed out by Lord Rutherford in a letter to *The Times* of April 29 A man of Kapitza's highly-strung type must inevitably be profoundly disturbed by a sudden frustration of years of work , and it comes as no surprise to his friends to learn from reliable sources that his health has already been seriously impaired by anxiety and strain The right of the Soviet to retain Kapitza in his native country can scarcely be questioned, but from the point of view of international science we venture to express the hope that he may be permitted to return to Cambridge to complete the investigations with the remarkable plant designed by him and installed in the Royal Society Mond Laboratory at the University

Retirement of Sir Peter Chalmers Mitchell

LAST summer it was announced that Sir Peter Chalmers Mitchell was to retire from the post he had held for more than thirty years as secretary of the Zoological Society of London (see NATURE, Aug 25, 1934, p 280) At the annual meeting of the Society held on April 29, Sir Peter formally vacated the secretaryship and his successor, Prof. Julian S Huxley, took his place. Sir Henry Mahon and Prof. J Stanley Gardiner presented Sir Peter with his portrait, painted by Mr William Nicholson, on behalf of some 1,250 members of the Society ; very appropriately, the background of the portrait includes a map of the Whipsnade estate, with the development of which Sir Peter's name will always be associated The response to the appeal for the portrait was so generous that it has been possible to send each subscriber a reproduction in colour of the portrait and also to present to Sir Peter a personal memento. The Duke of Bedford, president of the Zoological Society, in moving a resolution of thanks to Sir Peter for his many years of active and inspiring service to the Society and to science, stated that whereas in 1902 the Society's Gardens in Regent's Park had 69,500 visitors, in 1934 the number had increased to 1,690,000, while the Society's high reputation as a scientific body has been similarly enhanced The Society has been a pioneer, under the guidance of Sir Peter Chalmers Mitchell, in the improvement of the conditions under which animals are kept in captivity On the more strictly scientific side, mention should also be made of the valuable investigations carried out by the succession of anatomists, pathologists and other workers who have been encouraged by Sir Peter to study the Society's collections

King George's Jubilee Trust

No social change of our time is more significant than the way in which leisure has ceased to be the privilege of a few and become the concern, if not indeed the lot, of the many In the problems which leisure now presents, there is none more serious and pressing than those which it presents in adolescence The Jubilee Trust inaugurated by the Prince of Wales at St James's Palace on March 1 is designed specially to deal with such problems, and a further reference to its objects was made in an appeal broadcast by His Royal Highness on April 12 The main objects of the Trust are to provide more and better facilities for the recreation and guidance of the younger generation, to encourage the cultivation of abilities, craftsmanship and all those outdoor interests and activities which make for mental and physical fitness The Trust will assist, strengthen and extend the work of the many voluntary organisations in existence, the work of which is to promote the welfare of the boys and girls of Great Britain It will enable similar movements to be started in places at present untouched, particularly through lack of local resources and the need of help from a central source It should encourage co-ordination of effort and prevent the waste of money and effort in overlapping.

APART altogether from its direct activities, the existence of the Trust should encourage a more enlightened and generous attitude to the many problems which arise in regard to juvenile employment and leisure. It should lend powerful moral support to all agencies which are concerned with the education and recreation of young persons, whether in relation to industry or to citizenship. It may provide a focus from which powerful support will be forthcoming for all efforts to deal wisely with the tragedy of juvenile unemployment, with excessive hours of work or with any other matters which hinder the normal development of citizens possessing the qualities of physical, mental and spiritual fitness and ideas of service which make a people great. The Jubilee Trust aims at dealing with the most crucial educational task of the time—that of guarding from the worst dangers of unemployment or unsuitable work at the most critical time of their physical, moral and mental development that large section of our young people between fourteen and eighteen years of age who are drifting into manhood and womanhood with little guidance, and it should inspire not merely protective or remedial measures but also courageous efforts to deal with the root causes.

Chemical Industry at the Brussels Exhibition

PUBLICITY is a kind of vitamin or hormone essential for the proper growth of an industry. Like those accessories, it needs to be used constantly, judiciously and in appropriately small doses; an excess may do more harm than good, and the different varieties are more or less specific in their action. After a period of unrestrained enthusiasm, during which we sought rapidly to restore supposed deficiencies in vitamins of every alphabetical designation, we have learned to submit our requirements to the examination and prescription of experts; likewise we are learning that the best publicity is that which is well planned and well informed, that which is presented through the right channels by those best qualified, and that in which reality and literal truth are the corner-stones. The British chemical industry has been represented at many exhibitions, but for many years no demonstration of its ramifications and of the excellence of its products has been so comprehensive as that which has been arranged for the Brussels Universal and International Exhibition, 1935, opened by King Leopold on April 27. The exhibit, which is located in the British Government Pavilion, has been organised by the Association of British Chemical Manufacturers on a national basis; all sections of the industry have co-operated in its organisation and industrial firms have sunk their identity in order that the display might be truly national. It has been designed to show, by a series of tableaux, the modern applications in industry of selected chemicals. There are six main sections: heavy chemicals, agricultural chemicals, dyestuffs, coal-tar products, fine chemicals, and pharmaceutical chemicals; there are also exhibits of rayon and of the products of the new plastics or synthetic resin industry.

EVERY other industry depends to-day on the chemical industry, whether in the raw material, in the means of manufacture, in testing and control, or in the finished product. New industries have been created by the application of discoveries and inventions relating to chemical substances; old industries, such as agriculture, have been given a helping hand, as in the form of fertilisers and sprays. A clear impression of the degree to which industrial chemistry and chemical industry play their part in national life and in individual well-being is offered by the booklet which the Association of British Chemical Manufacturers has prepared in connexion with the Brussels Exhibition. The English edition—others in French, German and Spanish are being prepared—is of much interest apart from the exhibits which it describes; it is a waistcoat-pocket guide to the British chemical industry rather than the programme of a show. It gives a brief account of the part which Great Britain now plays in supplying with its chemical products not only its own needs and those of the Dominions and Colonies, but also the wants of foreign countries less happily placed. The booklet contains a list of firms and organisations which have contributed to the exhibit, together with statements of their principal products. This is the right sort of publicity; dignified, informative, accurate and interesting. The exhibitors deserve their due reward.

Aborigines and Australia

A CABLE from Adelaide in *The Times* of April 26 announces the composition of a Federal Board of Inquiry, which has been set up to investigate the treatment of the Australian aborigines. The Board will consist of three members, Prof. J. B. Cleland, professor of pathology in the University of Adelaide, Mr. White, acting Federal Chief Protector of Aborigines, and the Rev. J. H. Sexton, secretary of the Aborigines Friends Association of South Australia. The responsibility of the Federal Government of the Australian Commonwealth is limited to the aborigines of the Northern Territories, including the Arunta of the Alice Springs area, famous in the annals of anthropology as the tribes among whom the late Sir Baldwin Spencer and F. J. Gillen made their epoch-making investigations. Although a liberal policy has been pursued by the Federal Government in the protection of these aborigines, especially in the matter of endeavouring to ensure that they should have free access to their hunting grounds and to the springs and water-holes, allegations have been made recently that the aborigines are being forced off the land necessary to their livelihood. Attention has also been directed in a recent report of a Commission in West Australia, to which we hope to refer later, to the inadequacy of the arrangements for dealing with leprosy among aborigines. This is a Federal responsibility, a leprosarium being provided at Darwin, at which cases from the various States are received. The accommodation, it is stated, is inadequate, causing serious delay in evacuating cases from their point of origin, while, notwithstanding an agitation which has been proceeding for ten years, no steps have been taken towards a systematic examination of the aboriginal populations for the disease.

Broadcasting in Great Britain

THE Postmaster-General recently appointed a committee to consider the constitution, control and finance of the broadcasting services of Great Britain, including broadcasting to the Empire, television broadcasting and the system of wireless exchanges which will be conducted after December 31, 1936. He appointed as chairman Viscount Ullswater, and everyone will agree that this was a happy choice; but we were surprised to see that the committee did not include any men of science. We do not believe that any other country in the world would have appointed such a committee without a representative of science. Mr. Whitley was very proud of the new research department of the B.B.C. and was looking forward to it being a great help in the future. Already it has done valuable work, but little reference is made to it in the *B.B.C. Annual* for 1935. In our opinion, the addition of two or three scientific and technical men to this committee is necessary. So far as we can see, none of the committee has any real knowledge of the scientific principles underlying the problems its members will have to discuss. We hope that this will soon be remedied It is necessary to consider the instructional and entertainment values of broadcasting, but it would be foolish to neglect the scientific development of the art We have tried to find out from the *Annual* the amount expended in 1934 on research Unfortunately this does not appear, it is apparently included in the general sum of £334,959 mentioned on p 91 for maintenance, salaries, development and research, etc

Science and Social Responsibility

IN the April number of *State Service*, the journal of the Institution of Professional Civil Servants, Prof. H. Levy contributes an interesting article on this topic The social consequences, he says, that have flowed in the wake of technical advance stand now in such clear outline that even scientific men, traditionally concerned only with the internal content of their work and not with its external repercussions, are beginning to lose their complacency In the past, the scientific method excluded from its scope all matters involving prejudice, desire, bias or purpose, and was purely objective in character In the logic of the physical sciences, human desires play no part, but in the social sciences they are fundamental The pursuit of science is essentially a co-operative activity and is therefore socially conditioned It is directed to an end, and that end is its social purpose, but since the direction which scientific investigation takes is in this way socially determined, science itself becomes one of the determining factors of society It improves the technical level of production, it introduces new factors into the way of living for the population, it affects their cultural interests; it creates new needs and therefore arouses new hopes and desires In almost every walk of life, laws of detailed social behaviour on which action is based are already recognised Is it too much to suggest that here in small detail are the kinds of regularities and recurrences that make a science possible? Are we not therefore entitled to expect corresponding regularities, perhaps deeper and more far-reaching, on a large scale, and as a consequence, since society is dynamic, a logic of social change? Since science is itself a motivating factor in that change, its study is a scientific responsibility

British Trust for Ornithology

FIELD ornithologists in the British Isles are making an experiment in co operative research which, if successful, may have far-reaching implications They have a peculiar problem to deal with, partly because the great majority of them are not trained men of science, and yet are being led on to territory where an advanced scientific technique is essential Some of the combined operations recently carried out have been on an impressive scale The census of heronries in 1928 needed some five hundred observers before it was completed, while the great crested grebe inquiry of 1931 and the two-year woodcock inquiry now in progress have each enlisted more than a thousand observers. Naturally such work calls for a high degree of organisation, but until very recently British field ornithologists as such possessed no national organisation whatever Irreplaceable manuscripts, field-notes, photographs, maps and collections of literature or bibliography were got together and dispersed according to the hazards of individual existence A number of prominent ornithologists, including Mr H F Witherby, president of the British Ornithologists' Union and editor of *British Birds*, Prof. Julian Huxley, the Rev F. C R Jourdain, secretary of last year's International Ornithological Congress, and Dr P R Lowe of the British Museum, combined to fill this gap by forming the British Trust for Ornithology as a permanent national trustee for the interests of field ornithologists The Trust itself holds capital funds and assets in kind, such as a library, and collects subscriptions, which enable it to make grants for ornithological research These grants, which at present are only on a very small scale, are being used to develop the nucleus of an Institute of Field Ornithology at Oxford, recognised and administered by the University. A national planning committee for the ornithological programme as a whole has been set up jointly by the Trust and the University

THE Trust's first report just issued shows that, in spite of very cramped finances, a wide range of research has already been undertaken with marked success Special reference should be made to the enterprise of the Trust in starting an experimental annual index of heron numbers, based on a twenty-five per cent sample of the breeding heron population of England and Wales The index for 1934 is given as 102, 1928 being taken as 100 Another interesting point is the linking up of census work on swallows with a study of the size of broods, association with domestic animals at breeding places and occurrence of certain lethal parasites The inquiries into short-eared owl habits during a vole plague on a Forestry Commission estate, and into the effect of the recent drought on great crested grebes, are further examples of the broad range of research which this comprehensive and flexible type of organisation makes possible. The Trust is still in an experimental stage. Inquiries and offers of help should be addressed to the Honorary Secretary, Mr E M. Nicholson, 61 Marsham Street, London, S W 1

Earthquakes in Persia

DESTRUCTIVE earthquakes have recently visited the Persian province of Mazanderan that lies along the southern border of the Caspian Sea The first shock occurred on April 12, and was followed by others of greater severity during the next few days It is stated (*The Times*, April 24 and 27) that 28 villages have been destroyed and about 600 persons killed. The province is one that is seldom disturbed by great earthquakes, though it lies near the important centres of Teheran and Resht. Sir Arnold Wilson, in his valuable paper on earthquakes in

Persia (*Bull Sch Oriental Studies*, 6, 103–131 ; 1930), records two earthquakes in Mazanderan, in 1802 and 1820, that have hitherto escaped the attention of seismologists By the earlier shock, 70 towns and villages were destroyed, while the towns of Semnan and Damghan, to the south of the province, were seriously damaged

Rockefeller Medical Fellowships

THE Rockefeller Medical Fellowships for the academic year 1935–36 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1, 1935 These Fellowships are provided from a fund with which the Medical Research Council has been entrusted by the Rockefeller Foundation Fellowships are awarded by the Council, in accordance with the desire of the Foundation, to graduates who have had some training in research work in the primary sciences of medicine, or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States or on the Continent of Europe, before taking up positions for higher teaching or research in the British Isles A Fellowship held in America will have the value of not less than £350 a year Full particulars and forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

Announcements

HIS MAJESTY THE KING has conferred his patronage on the fifty-fourth annual meeting and conference of the Society of Chemical Industry to be held in Glasgow on July 1–6 Among the subjects to be discussed are the transport of food by road, rail and sea, problems of water supply, and chemical engineering in the Navy

WE regret to announce the death, on April 27 at the age of seventy-three years, of Prof H. B Baker, F.R S , lately professor of general chemistry in the Imperial College of Science and Technology

DR. GEORGE SARTON, editor of *Isis*, the quarterly organ of the History of Science Society and of the International Academy of the History of Science (Harvard Library, 185, Cambridge, Mass., U S A), has been elected a corresponding member of the Academia de la Historia of Madrid.

THE Ramsay Memorial Fellowships Trustees will consider at the end of June applications for a Ramsay Memorial Fellowship for chemical research, of the value of £250 a year. Particulars of the award can be obtained from the Secretary of the Ramsay Memorial Fellowships Trust, University College, London (Gower Street, W C.1)

THE Linacre Lecture at St John's College, Cambridge, will be delivered by Mr. P. P Laidlaw, pathologist to the Medical Research Council, National Institute for Medical Research, on Tuesday, May 7, at 5 p.m. in the new lecture-room of physiology The title of the lecture will be "Epidemic Influenza . A Virus Disease".

A COURSE of eight lectures on pathological research in its relation to medicine is being given on Thursdays, commencing May 2, at the Institute of Pathology and Research, St Mary's Hospital, W 2 The lecturers are Sir Almroth Wright, Prof E D Adrian (electrical activity of the brain), Dr I N Asheshov (bacteriophage), Dr C H Andrewes (cancer), Dr R G Canti (cultivation of living tissue), Sir Henry Dale (active substances of ergot), Mr J Henderson Smith (virus diseases of plants and animals) and Dr J Needham (chemical embryology) The lectures are open to members of the medical profession and medical students, without fee

THE seventh Natural Science Congress of the Dutch Indies will be held at Batavia on October 23 26 The agenda will include addresses by Prof R Remmelts and Dr L J C Van Es as well as meetings of sections Further information can be obtained from the Secretariat, Koningsplein Z11, Batavia

A SPECIAL exhibition of welding has been arranged at the Science Museum, South Kensington, and will remain on view until May 15 The exhibits include a wide range of machines used in welding by the oxy-acetylene, resistance, atomic hydrogen and arc processes, and a representative selection of examples of welded work Demonstrations of the first three processes are being given daily at 11–1 and 3–5, and films illustrative of welding are being shown every afternoon in the Lecture Theatre at 4 The exhibition is supplementary to the symposium on welding on May 2–3 organised by the Iron and Steel Institute in co-operation with a number of other technical societies and institutions

APPLICATIONS are invited for the following appointments, on or before the dates mentioned .—An assistant (II) for research in aero engines and accessories at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 7) A laboratory research assistant in the Glamorgan County Mental Hospital, Bridgend—The Medical Superintendent (May 15) An assistant (Grade III) for abstracting scientific and technical papers in the Department of Scientific and Industrial Research—The Establishment Officer, 16 Old Queen Street, Westminster, S W 1 (May 15) A head of the Mechanical Engineering Department, Central Polytechnic, Croydon—The Education Officer, Education Office, Katharine Street, Croydon (May 15) An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S W.1 (June 10) A lecturer in mathematics in Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield A principal of the Swansea Technical College—The Director of Education, Swansea An assistant for soil survey work at Harper Adams Agricultural College, Newport, Shropshire—The Principal A lecturer in geography in Armstrong College, Newcastle-upon-Tyne—The Registrar.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 765.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Green Flash at Sunset

OBSERVATIONS of the green flash have frequently been recorded in NATURE, and Lord Rayleigh[1], by simple and beautiful experiments with an artificial source of light and a prism the dispersion of which was equal to atmospheric dispersion, has imitated the chief phenomena of the coloured flash observed at sunset. This experimental imitation strongly supported the generally accepted view that the green flash is primarily due to atmospheric refraction, dispersion and differential scattering. The discussion following Lord Rayleigh's paper read before the Physical Society indicated, however, that before a satisfactory explanation of all the observed phenomena could be given, further observations were required.

The phenomenon is probably by no means so infrequent as is generally supposed, and may even be the rule rather than the exception when the horizon is clear and the observer at a sufficient altitude. The rarity of the green flash at sea-level is possibly due to the horizon being too near for the dispersion to be perceptible.

Recently I had an opportunity of making a number of observations of the coloured flash on the west coast a few miles north of Auckland from a hill about 180 feet high. On one occasion Mr. H. B. Lusk, who had observed the green flash with me from the hill on the two previous evenings, was on the beach at sunset and reported that no green flash was visible, though it was clearly seen by me and by other observers from the hill.

On several occasions I observed the setting sun with an × 30 army pattern telescope. One evening there was obvious stratification of the atmosphere. At the moment before sunset the sun appeared orange-red through the lowest stratum, which was about a third of the diameter of the sun in thickness, orange through a second stratum of about the same thickness and light yellow above. The marked turbulence of the rim of the sun appeared to have a horizontal tendency. When about a fifth of the diameter of the sun remained above the horizon, the sun appeared orange through the telescope and the turbulent rim was fringed with green, which became more evident as the sun sank. Just before the sun disappeared, a small narrow horizontal strip appeared to become detached from the top of the sun. During detachment the ends and upper edge of this fragment were green. The green rapidly invaded the strip, which at the moment of detachment was completely grass green in colour, the much larger mass of the remaining sun appearing orange. As the sun disappeared below the horizon, the last narrow edge turned bright green before disappearing.

On another occasion when the sky was unusually clear, the setting sun was almost too bright to observe with the naked eye. Through the telescope it appeared yellow with the lower part tending to orange. When the sun had set to about four-fifths of its diameter, the turbulent edge of the sun appeared to have a narrow fringe of brilliant violet. As the sun set, this changed gradually to a bright spectrum blue. A small fragment became detached as in the previous case, but instead of being green was a brilliant blue at the moment of separation. The last tiny portion of the sun to disappear became bright blue-green before sinking below the horizon.

Although the primary cause of the coloured flash may be atmospheric dispersion, simultaneous colour contrast may very considerably modify the subjective colour effect. I had the privilege of seeing Dr. J. S. Haldane's experiments referred to by Lord Rayleigh and have seen other remarkable simultaneous colour contrast effects. Some years ago in Auckland the nearly full moon shortly after sunset appeared grass green. I telephoned to a neighbour asking him to look at the moon and tell me its colour, and was not a little relieved when he reported that it was green. I concluded at the time that the effect was due to colour contrast, the sky being highly coloured. In the case of the setting sun, the contrast is between the coloured edges or fragments and the more luminous remainder of the sun, not the background.

F. P. WORLEY.

Auckland University College,
Auckland, N.Z.
March 1.

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[1] *Proc. Roy. Soc.*, A, 126, 311, 1930. *Proc. Phys. Soc.*, 46, 487, 1934.

I HAVE read Prof. Worley's letter with interest, and can agree with him that the green flash is by no means a rare phenomenon. On a recent trip to the West Indies, I saw it three times out of a total of five sunsets observed, using a field glass × 7. It was just about as conspicuous as the experimental work would lead one to anticipate. Circumstances unfortunately prevented my observing further sunsets, as had been hoped.

RAYLEIGH.

Terling Place, Chelmsford.
April 5.

Striated Muscles of an Amber Insect

IT is well known that arthropods found in Baltic amber are unusually well preserved, so that even the minutest features of their chitinous structures are plainly visible under considerable magnification. The internal organs, however, are usually completely disintegrated, nothing but the amber mould of the chitinous skeleton remaining. It was therefore something of a pleasant surprise to discover a specimen of an amber fungus-gnat in which the flexor and extensor muscles of the tibia, located in the femur, are so well preserved in all legs, that not only their outlines, but also the transverse striations of the fibres, may be clearly seen under the microscope at a linear magnification of 300 : 1 (see Fig. 1).

The specimen belongs to the British Museum (In. 18753, 92 74) and is in the same piece of amber with a spider, forming part of a collection loaned to me for study through the courtesy of the Department of Geology. Unfortunately, the wings of the fly are broken off at their base, making identification of the species and even of the genus impossible except by matching with specimens in some other, identified collection. Presumably it is a species of *Sciara*, this genus being extensively represented in the Baltic amber. The small insert in the photograph shows the fly at a magnification of 15. The femora with the muscles had to be photographed at a magnification of 300 : 1 with the aid of a low power objective and a high-power ocular, the combination being necessitated by the thickness of the amber. [In reproducing the photograph, it was reduced to $\frac{3}{5}$.] The best results were obtained with infra-red rays.

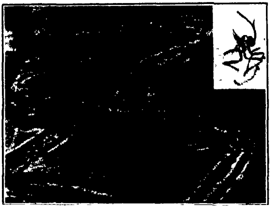

FIG. 1. Infra-red photograph of a Baltic amber fungus-gnat (*Sciara* sp.?) showing transversely striated flexors and extensors in the legs (× 180). Insert (× 15). Photographed by Prof. Petrunkevitch.

The reason why the striations do not show nearly as well in the photograph as when the specimen is examined directly under the microscope, lies in the fact that one cannot change the focus during exposure, or increase its depth sufficiently to show all lines at the same level.

So far as I know, this is the first instance of striated muscles found in fossil insects. In 1902, Bashford Dean[1] described and figured transversely striated muscles in a Devonian shark. Vertebrate muscles, unprotected by anything but an easily perishable skin, are quick in deteriorating, yet for the same reason, under favourable conditions, may be penetrated by soluble salts serving as a preservative. Not so in arthropods. Only rupture of the outer skeleton admits fluids to the inner organs. This particular gnat must have been injured at the time that it was caught in the still fluid gum, which oozed through the wound, entering the legs and embalming the muscles before they had time to decompose.

ALEXANDER PETRUNKEVITCH.

Osborn Zoological Laboratory,
Yale University,
New Haven,
Connecticut.
March 15.

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[1] Bashford Dean, "Presence of Muscle Fibres in Sharks of the Cleveland Shale", *Amer. Geol.*, 30, 1902.

Nature of the Thermal Agitation in Liquids

THE accompanying photographs (Fig. 1) represent the analysis by a Fabry-Perot *étalon* of the structure of the 4046 A., 4078 A. and 4358 A. radiations of a low-density water-cooled mercury arc, after they are scattered through an angle of 180° by a column of carbon tetrachloride liquid. In each case, two different temperatures of the liquid column (30° C. and 70° C.) were employed, the exposures being as nearly as possible otherwise under identical conditions.

The choice of a Fabry-Perot étalon as the high resolving power instrument and of carbon tetrachloride as the scattering liquid were both determined by experience gained in this particular field of research[1]. It will be seen that a 40° rise of temperature produces *a most remarkable change* in the structure of the scattered radiation. The two Brillouin components having a Doppler shift determined by the velocity of sound in the liquid, which are well-defined at the lower temperature, broaden greatly when the liquid is heated, and move in towards the central component, practically closing in upon it. The central component at the same time increases in intensity. The conception that ordered wave trains of sound constitute the thermal energy in a liquid therefore departs more and more from the actual facts as the temperature of liquid is raised.

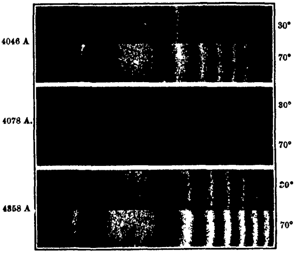

FIG. 1

C. V. RAMAN.
B. V. RAGHAVENDRA RAO.

Department of Physics,
Indian Institute of Science,
Bangalore.
March 24.

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[1] B. V. Raghavendra Rao, *Proc. Ind. Acad. Sci.*, 1, 261 and 473, 1934–35.

Use of Hydrogen Cyanide in Fumigation

THE recent tragic death of two children from hydrogen cyanide fumes following the fumigation of their home in Aldershot has directed attention to the need for stricter control of the practice of fumigation and to the need for fuller knowledge of it. For some years past I have strongly urged the need for the licensing of fumigators, and the question has, I believe, received consideration by officials of the

Ministry of Health and of the Home Office While one fully appreciates the difficulties which the licensing of fumigation presents, the dangers to which innocent members of the community are exposed justifies a serious effort to overcome them One firm which supplies the greater part of the hydrogen cyanide used for fumigation purposes in Great Britain is playing its part by restricting supplies to fumigation firms and fumigators of known repute and competency

Fumigation of houses, warehouses and mills, and of foodstuffs and other materials, is much more widely practised than is generally known The recent formation by the Medical Research Council of a committee charged with the investigation of the bed-bug problem as an important factor in slum clearance, and the promotion by that committee of research on fumigation as applied to houses, is an important step in the right direction Until the formation of that committee, research on fumigation and fumigation methods in Great Britain was dependent for financial support almost solely on firms manufacturing insecticides, or on firms directly interested in the fumigation of food-stuffs and other consumable stores, such as tobacco.

The use of fumigants for the destruction of rats on ships has long been recognised, and is indeed insisted on as part of an international campaign against plague, but the use of fumigants against insects infesting food-stuffs and other consumable stores is still in some circles regarded with disapproval, and although tolerated is not encouraged A main argument for this attitude is that if food-stuffs were stored and transported under proper hygienic conditions, there should be no need for fumigation, and that just as preservatives in food-stuffs have been dispensed with by food manufacturers, so should fumigants be unnecessary The two cases are not comparable for a number of reasons. The habits and behaviour of insects are more complex and far less well understood than the biology of bacteria Then the use of preservatives was naturally applied to food-stuffs just prior to marketing and packed in small bulk, in other words, preservation was a factory process. Now infestation of food-stuffs by insects may occur during harvesting and at any stage thereafter until the factory is reached, and the quantity of material to be treated may amount to thousands of tons. It is impracticable to ensure absolute protection of such a large bulk of produce from insect infestation in our present state of knowledge of the insects' biology; and, however desirable it may be that sterilisation of food-stuffs by fumigation should be dispensed with, that is no more practicable at present than to dispense with fumigation practice in slum clearance

Meanwhile, it is surely better ,that the need for fumigation in the marketing of food-stuffs should be recognised, that those firms concerned which are enterprising enough to inaugurate and support researches designed to make fumigation safer and more efficient should be encouraged in their work; and that every effort should be made to prevent fumigation falling into disrepute, mainly because it is not sufficiently recognised as a scientific process and its application is not restricted to those adequately trained in its theory and practice.

J W. MUNRO.

Dept. of Zoology and Applied Entomology,
Imperial College of Science and Technology,
South Kensington, S W.7

Mechanism of Respiration

UNDER the above heading, Prof A. Szent-Györgyi makes the wide statement[1] that respiration consists mainly of a reversible oxidation of succinic and malic acids to fumaric and hydroxy-fumaric (oxaloacetic) acids. Succinic and malic acids are activated by specific dehydrases and "only these two dehydrases seem to be connected immediately with the Warburg-Keilin system"

These conclusions are probably accounted for by the fact that Szent-Györgyi used minced tissues It has been shown by Elliott and Schroeder[2] that, while slices of kidney tissue will carry out a cycle of reactions in the oxidative removal of lactic and pyruvic acids, on mincing the tissue, only the power to oxidise succinate to fumarate and to convert fumarate to malate remains, all the other oxidising agencies concerned in the cycle, as well as various other mechanisms, are completely destroyed.

In collaboration with Z Baker and M Benoy, I have now shown that slices of two types of transplantable rat tumour, a sarcoma and a carcinoma, while respiring at a rate equal to that of many other tissues, are quite unable to oxidise succinic or malic acid These acids, therefore, cannot be the centre of activity in this type of tissue Details of this work will be published shortly elsewhere

Szent-Györgyi also appears to overlook the work of Harrison[3], who has shown that glucose with its dehydrogenase and co-ferment can react with the cytochrome-indophenol oxidase system

K A C ELLIOTT

Cancer Research Laboratories,
Graduate School of Medicine,
University of Pennsylvania,
Philadelphia.
March 8

[1] NATURE, **135**, 305, 1935.
[2] *Biochem J*, **28**, 1920, 1934
[3] *Biochem J*, **25**, 1016, 1231

Phenosafranine as an Anticatalyst of the Pasteur Effect

ALTHOUGH since Pasteur it has been recognised that in a wide variety of animal and vegetable cells the respiration is able to suppress the appearance of products of fermentation, the mechanism of this effect is still obscure. At present, the use of reagents which specifically interrupt this link between the two main energy-liberating reactions of cells appears to offer the principal means of its investigation In the course of work on the action of reversible oxidation reduction systems on tissue metabolism, I have found that the dyestuff phenosafranine proves to be the most vigorous specific inhibitor of the Pasteur effect yet described.

The active concentration of phenosafranine is with brain tissue 10^{-5} molar, it is therefore some hundred times as active as ethyl *iso*cyanide (Warburg[1]), aminonaphtholsulphonic acid (Krah[2]), glutathione (Bumm and Appel[3]) or phenyl hydrazine (Dickens[4]), and is active in one ten-thousandth of the concentration of potassium chloride recently used by Ashford and Dixon[5]. When slices of rat brain are suspended in Ringer solution containing glucose, in the Warburg apparatus, and phenosafranine in $10^{-5}M$. concentration is added, the essentially carbohydrate respiration (Q_{O_2} in table) of brain continues unimpaired, the respiratory quotient (*R.Q.*) remains at the carbohydrate level, but the aerobic acid formation ($Q_G^{O_2}$) rises to a value near or equal to that normally found only under anaerobic conditions The acid formed, estimated by Clausen's method, proves to be lactic acid.

Expt. (min)	Medium	Control			Phenosafranine 10^{-4} *M*		
		Q_{O_2}	$Q_G^{O_2}$	*R Q*	Q_{O_2}	$Q_G^{O_2}$	*R Q*
100	Bicarb	− 11 5	+ 2 0	—	− 14 9	+ 15 2	—
90	Phosphate	− 12 8	—	1 01	− 11 6	—	0 98
120	Bicarb	− 13 2	+ 1 7	1 02	− 14 4	+ 11 1	0 98

Thus the complete separation and simultaneous occurrence of carbohydrate oxidation and fermentation is demonstrated in intact animal cells under conditions closely approximating to the physiological

In tumours, unlike most normal tissues, the respiration is inadequate to suppress the lactic acid formation (Warburg[6]), the carbohydrate oxidation is defective (Dickens and Simer[7]) Phenosafranine specifically inhibits the Pasteur mechanism in tumours also :

	Expt (min)	Medium	Control		Phenosafranine 3 × 10^{-4} *M*	
			Q_{O_2}	$Q_G^{O_2}$	Q_{O_2}	$Q_G^{O_2}$
Jensen sarcoma	60	Bicarb	− 10 8	+ 28 3	− 9 7	+ 44 9
Walker carcinoma	30	,,	− 12 1	+ 20 9	− 8 8	+ 39 5

Thus whilst in both normal and tumour tissue a widespread correlation between carbohydrate oxidation and carbohydrate fermentation normally exists (Dickens and Simer[7]), phenosafranine in both groups of tissue is able, when present in extremely low concentration, to break down specifically and completely the coupling reaction between these two fundamental routes of carbohydrate katabolism in the living cell

F DICKENS

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Royal Victoria Infirmary,
Newcastle-on-Tyne
March 8

[1] *Biochem Z*, 172, 432, 1926.
[2] *ibid.*, 219, 432, 1930
[3] *Z. physiol Chem*, 210, 79, 1932.
[4] *Biochem. J*, 28, 537; 1934
[5] *ibid*, 29, 157, 1935
[6] "Stoffwechsel der Tumoren", Springer, Berlin, 1926.
[7] *Biochem. J.*, 24, 1301; 1930 25, 985; 1931

Application of Low Temperature Calorimetry to Radioactive Measurements

IT is often of importance to determine in absolute measure energy changes connected with radioactive transformations, but only in a few cases has it been possible to employ calorimetric methods for this purpose, since in general the amounts of energy liberated in unit time are too small. The sensitivity of calorimetric measurement can be increased, however, by many orders of magnitude by working at very low temperatures, and it may be worth while to point this out, as low temperature technique is now within the reach of non-specialised laboratories.

Consider a calorimeter consisting of lead. At a temperature of 1·3°, which can easily be obtained with liquid helium, its specific heat is 3,000 times smaller than at room temperature. So the calorimetric sensitivity is increased by this factor if we take the temperature sensitivity as constant. Using a substance like tungsten, with a higher θ_{Debye}, one can increase this factor still further by one power of 10 If one wishes to measure the heat developed with an accuracy of 1 per cent, the temperature must be allowed to change by 1/10°, assuming that the measuring sensitivity is 1/1,000°–1/10,000° The effects can be accumulated over a period of at least ten minutes, as at very low temperatures the thermal insulation can be made nearly perfect, owing to the lack of radiation Thus, using a calorimeter consisting of 1 cm ^{3} of tungsten, one could measure 10^{-8} cal /sec , which is about 1,000 times more sensitive than in the calorimeter of Meitner and Orthmann[1] So, for example, the total heating effect of 10^{-8} gm of radium situated within the calorimeter could be determined, or the heating caused by the γ-rays from a source of 0 1 millicurie of radon placed 3 cm away from the calorimeter

Cooling the calorimeter below 1° by the magnetic procedure, one can diminish still further the specific heat of the absorbing substance, and at the same time the sensitivity of the temperature measurement is considerably increased by basing it on the susceptibility of the paramagnetic salt, for, in the region where the Curie law holds, the accuracy of temperature measurement is proportional to $1/T^2$ With a substance obeying the T^3 law for the specific heat, therefore, the sensitivity of this method increases with falling temperature with T^{-5}

The specific heat of a paramagnetic salt, however, does not follow the T^3 law, as its specific heat must necessarily be anomalous in this temperature region[2] No great increase in sensitivity could therefore be achieved below 1° by working with a calorimeter consisting of the salt alone. But, of course, this does not apply to an appropriate combination of the paramagnetic salt and an absorbing substance of non-anomalous specific heat

In some preliminary experiments carried out during the past few weeks, Dr Kurti and I nevertheless worked with the unfavourable case of the salt alone in order to be able to use our ordinary apparatus for magnetic cooling[2] We took 1 gm of iron ammonium alum and cooled it down to 0 05°, which in this case was an advantage solely because of the improved thermal insulation[2] In spite of the very small absorption coefficient of the substance for γ-rays, and the comparatively low thermometric sensitivity of this particular apparatus, a sharp rise of temperature set in immediately after the substance had been exposed to the γ-radiation of 100 millicuries of radon at a distance of 2·5 cm (This turned out to be a very convenient way for measuring the specific heat of the salt and we will report soon on the results) Even in this unfavourable case, we could measure 10^{-8} cal /sec , and it should be possible to measure, in a volume of about 1 cm ^{3}, an evolution of heat of the order of 10^{-11} cal./sec., by using a suitable absorbing substance in combination with the paramagnetic salt and improving the sensitivity of the temperature determination

With such increased sensitivity, various problems can be attacked, and experiments in this direction are in progress at the Clarendon Laboratory.

F SIMON

Clarendon Laboratory,
Oxford
March 28.

[1] L. Meitner and W. Orthmann, *Z. Phys*, 60, 143; 1930
[2] N. Kürti and F. Simon, *Proc Roy Soc.*, A, 149, 152, 1935.

Internuclear Distance and Vibration Frequency for Diatomic Molecules

THE equilibrium internuclear distance r_e and the vibration frequency ω_e for diatomic molecules were connected by Morse in the formula $\omega_e r_e^3 =$ const $= 3{\cdot}000 \times 10^{-21}$ cm.^{2} for many molecules This, however, does not hold accurately, and in fact the constant shows a periodic error Douglas Clark has proposed a modified formula, $\omega_e r_e^3\sqrt{n} =$ const , where n is the 'group number', and is the number of 'shared electrons', usually the sum of the valency electrons in the atoms composing the molecule This constant varies for each molecular period, and appears to be quite arbitrary Neither of these formulæ is capable of fitting the case of isotopes, for which r_e has the same value, while ω_e depends on the reduced mass

We have considered a formula involving the reduced mass μ, namely, $\omega_e r_e^3\sqrt{\mu} =$ const., and examined it with relation to experimental data for non-hydride molecules Using Clark's nomenclature, it is found that for the molecular periods *KK*, *KL* and *KM* which he discussed, the agreement is very nearly as good as with his formula and almost certain to be within the limits of observational error. In addition, it gives identical constants for the isotopes $B^{10}O$ and $B^{11}O$, and for H_2 and HD

The formula also gives consistent results for the *LL* and *MM* periods, and it is found that the constant for the *KL* period is the mean of the constants for the *KK* and *LL* periods, and that for *KM* the mean of *KK* and *MM*. Finally, the constant for each period is no longer arbitrary, but is approximately proportional to the number of completed electronic shells in the molecule, the value for the *KK* period being $10{\cdot}6 \times 10^{-33}$ gm.$^{\frac{1}{2}}$ cm ^{2}.

We hope to publish a fuller account of this work shortly

H S. ALLEN
A K. LONGAIR

Physical Laboratory,
University,
St Andrews
March 20

Raman Spectra of some Deuterium Compounds

USING a high intensity glass spectrograph with a dispersion of 15 A per mm. we have measured the Raman frequencies of tetrachlordeuterium-ethane and *cis-trans* deuterium-dichlorethylene prepared from heavy water. The results are briefly given below, together with mean values of the Raman frequencies (cm.$^{-1}$) of the corresponding light hydrogen compounds taken from earlier measurements[1] for comparison. Intensities are given in brackets.

$C_2D_2Cl_4$: 174(4), 240(8), 287(4), 352(8), 399(1), 532(2), 623(6), 701(2), 739(5), 947(3), 2240(6)
$C_2H_2Cl_4$. 171(4), 236(6), 286(4), 351(5), 395(2), 544(2), 644(4), 761(2), 802(5), 1212(2), 2984(6)
$C_2D_2Cl_2$ (*cis*): 176(6), 368(3), 515(1½), 689(6), 850(8), 1570(6), 1507(2), 2325(6)
$C_2H_2Cl_2$ (*cis*) 173(6), 406(4), 565(2), 714(5), 806(½), 878(½), 1182(4), 1587(5), 1687(1), 3080(7)
$C_2D_2Cl_2$ (*trans*): 346(4), 657(1), 759(2), 992(6), 1570(6), 1547(3), 2325(4)
$C_2H_2Cl_2$ (*trans*). 351(7), 763(2), 846(3), 1271(5), 1578(3½), 1625(½), 1694(½), 3077(4)

The isotope effect is in many cases clearly determinative and indicates the participation of the hydrogens in the different oscillations. Thus the alteration of the C–H frequency is specially strong; in tetrachlorethane, for example, we have.

CH : $= 2984$ cm $^{-1}$ and CD : $= 2240$ cm.$^{-1}$ in dichlorethylene :
CH $= 3080$ cm.$^{-1}$ and CD $= 2325$ cm.$^{-1}$.

An approximate estimate of the bond strength, using elementary vibration theory, gives a greater value for deuterium than for light hydrogen in these compounds

We intend to discuss these new results further elsewhere in conjunction with earlier polarisation measurements[2]

B TRUMPY

Geophysical Institute,
Bergens Museum,
Bergen,
March 26.

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[1] K W. F Kohlrausch, "Smekal-Ramaneffekt"
[2] B Trumpy, *Z Phys*, **90**, 133 1934 **93**, 624 , 1935

X-Ray Study of Recovery and Recrystallisation of Aluminium Single Crystals

To study recovery and recrystallisation after deformation, we have adapted the rotation method of crystal analysis with flat films placed in front of and behind the specimen.

The aluminium single crystals were deformed by extension by 5–16 per cent It is well known that the asterism in the process of recovery does not change. Distinct changes in the distribution of intensity among the spots, sometimes accompanied either by their shortening or elongation, with simultaneous increase in their sharpness could be seen on some elongated spots on the X-ray pictures taken by back reflection (see Fig. 1, *a* and *b*).

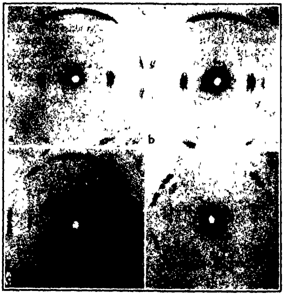

FIG. 1. X-ray analysis of single crystals of aluminium. (*a*) Deformation texture and (*b*) recovery after 2 hours at 300°. (*c*) Deformation texture and (*d*) texture after recrystallisation.

We consider this phenomenon to be the result of the removal of stresses and straightening of the elastically bent separate parts of the deformed single crystal.

Some of the deformed single crystals (10, 12 and 16 per cent extension) have again become single crystals after recrystallisation at temperatures coinciding with those of Karnopp and Sachs[1], but with an orientation absolutely different from that of the deformed crystal (see Fig. 1, *c* and *d*).

N. SELJAKOW
E. SOWS

Institute of Metals,
Leningrad

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[1] R. Karnopp and J. Sachs, *Z. Phys.*, 42, 283; 1927.

α-β Transformation of Muscle Protein *in situ*

IN a recent letter[1] we described the prediction and discovery by X-rays of an α-β intramolecular transformation on stretching myosin, and pointed out the close analogy in molecular configuration and elastic properties between myosin and the labile ('supercontracting') form of hair keratin. We are now able to report that we have at last succeeded in bringing about the transformation by stretching muscle itself. Details will be given elsewhere: at the moment, the change has been demonstrated both in frog's sartorius muscle and in the retractor muscle of the foot of *Mytilus edulis*.

Shortly after writing our previous letter, we became acquainted with an almost simultaneous paper by H. H. Weber[2], describing independent optical and elastic experiments on myosin threads. It is interesting to note that Weber's results also indicate, as is shown directly and unambiguously by X-ray analysis, that the myosin molecule is normally in a folded configuration endowed with inherent long-range elasticity.

W. T. ASTBURY
SYLVIA DICKINSON

Textile Physics Laboratory,
University of Leeds.
April 11.

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[1] NATURE, 135, 95, Jan. 19, 1935.
[2] *Pflüg. Arch. Physiol.*, 235, 205; 1934.

Points from Foregoing Letters

THE green flash at sunset is a common occurrence when overlooking the sea from a certain height, according to Prof. F. P. Worley, of Auckland, New Zealand. In one instance fringes of violet and of blue preceded a final blue-green. From this and from the fact that on one occasion the full moon shortly after sunset appeared green, Prof. Worley concludes that while atmospheric dispersion may be the primary cause of the coloured flash, the contrast between the coloured edges and the non-luminous remainder of the setting sun may modify considerably the subjective colour effects.

The structure of the softer parts of fossil animals is relatively seldom maintained. Prof. A. Petrunkevitch submits a photograph of the transversely striated muscle of a fungus-gnat (probably *Sciara*) which had been embalmed some thirty million years ago in a piece of amber, now in the British Museum.

From the change in the structure of the light scattered by carbon tetrachloride when the temperature of the liquid is raised, Sir C. V. Raman and Mr. B. V. Raghavendra Rao infer that, as the temperature increases, the thermal energy of liquids becomes less like that of ordered wave-trains of sound.

Prof. J. W. Munro appeals for stricter control of the practice of fumigation and for support of research to make fumigation safer and more efficient, so that it may also be applied in the case of insects infesting foodstuffs and other consumable stores.

Dr. K. A. C. Elliott finds that cancer tissue of the rat, while respiring at a rate equal to that of many other tissues, cannot oxidise succinic or malic acids. He therefore disagrees with Prof. Szent-Györgyi's generalisation that respiration consists mainly in the reversible oxidation of those acids and believes that Prof. Szent-Györgyi's findings apply mainly to minced tissues.

Living cells derive their energy largely from the oxidation or break-up of sugar-like substances. In the absence of oxygen, lactic acid is formed (fermentation). If oxygen is present the sugar is completely oxidised to carbon dioxide, and the lactic acid disappears (Pasteur effect). Dr. F. Dickens finds that in the presence of traces of the dye-stuff phenosafranine, the respiration of brain tissue produces both carbon dioxide and lactic acid, so that the Pasteur effect is apparently inhibited.

At temperatures near the absolute zero, the amount of heat necessary to produce an appreciable change in temperature is very much smaller than at ordinary temperature. Taking advantage of this fact, Dr. F. Simon has constructed a low-temperature calorimeter which registers 10^{-6} cal./sec. He discusses the means for increasing the sensitivity a thousand-fold so as to be able to measure by means of the heat emitted the absolute energy connected with many radioactive transformations.

Prof. H. S. Allen and Mr. A. K. Longair point out that the simple formulæ which, in a diatomic molecule, connect the vibration and the internuclear distance (magnitudes deduced from the band spectra of the light emitted by such molecules) do not hold accurately. They propose to introduce another factor, the 'reduced mass' (equal to the product of the masses of the atoms divided by their sum). This makes the formula fit better and renders the 'constant' for each period approximately proportional to the number of completed electronic shells in the molecule.

The spectra of the light scattered by certain compounds of carbon, chlorine and heavy hydrogen ($C_2D_2Cl_2$. $C_2D_2Cl_4$) have been compared by Prof. B. Trumpy with those of the corresponding compounds containing ordinary hydrogen (di- and tetrachlorethane). From changes in the wave-length of some of the spectrum lines, he deduces how the hydrogen atom participates in certain intra-molecular oscillations.

Messrs. N. Seljakow and E. Sows submit photographs showing the changes taking place in the shape and intensity of the spots of X-ray defraction patterns, when single crystals of aluminium are deformed by extension and then allowed to recover. They consider the changes to be due to the removal of stresses and straightening of the elastically bent separate parts of the deformed single crystal.

Science News a Century Ago

Work of the Cambridge Observatory

According to the *London and Edinburgh Philosophical Magazine*, at a meeting of the Cambridge Philosophical Society held on May 4, 1835, "Prof. Airy gave an account of recent results obtained at the Observatory , namely, 1st, That the discrepancy of the observations of the obliquity of the Ecliptic at the summer and winter solstices formerly noticed, had disappeared on using the refraction corresponding to a new barometer which stands 1·10th of an inch higher than one formerly used 2nd, That the mass of Jupiter, as determined by observations of the 4th Satellite in 1834, is almost exactly the same as that obtained in 1832 and 1833, namely 1–1048th of the Sun's mass 3rdly, That the time of rotation of Jupiter, as determined by a spot, is 9h, 55m, 21s the spot from which the determination was obtained made 225 revolutions in 93 days "

Marine Meteorology at the Royal Society

At a meeting of the Royal Society held on May 7, 1835, at which Sir John Rennie presided, five papers were read, including three on marine meteorology, communicated by Capt Beaufort, R N They were entitled "Hygrometrical Observations made on board His Majesty's surveying vessel Ætna", "Meteorological Register *from* the 1st of January to the 1st of November 1834" and "Meteorological Register kept on board His Majesty's Ship Thunder, between the 1st of January and the 30th of June 1834". This last 'register' had been kept by R Owen, Commander, while the other, from January 1 until November 1, 1834, had been kept by Edward Barnett and contained observations made during a voyage across the Atlantic

Cooking by Gas

On May 7, 1835, a correspondent, "M. P.", writing from Hitchin to the editor of the *Mechanics' Magazine*, began his letter : "If any of your long list of readers are smitten with the desire of diffusing useful knowledge, and are in possession of the information I seek, they will thank me for affording them an opportunity of indulging that laudable and fashionable propensity." A gas works had just been erected in Hitchin, and attempts were being made to use the gas for cooking. "M P " said they had tried an apparatus described in the fifteenth volume of the *Mechanics' Magazine*. "It consists," he said, "of nothing more than a cylinder of thin sheet iron, twelve inches high, six inches wide at the bottom and three at the top. The bottom is open and the top is covered with a piece of thin wire gauze." The gas pipe being carried up two inches into the cylinder, the gas jets mixed with the common air and ascended together through the gauze and were set fire to at the top. Results of experiments, "M. P." said, showed that two quarts of water could be boiled by the application of three feet of gas, and as the price of gas was 12*s*. 6*d*. per thousand feet the expense was only a halfpenny. He was, however, desirous of having further information on the subject.

Wheatstone on Speaking Machines

At the Royal Institution on May 8, 1835, Wheatstone delivered a lecture on speaking machines. Mr. Wheatstone, said the *Record of General Science*, gave an account of the different attempts which had been made to invent speaking machines from the time when the oracular responses were delivered at Delphi, through the period when a speaking head was exhibited by the Pope towards the end of the tenth century, and others afterwards by Roger Bacon and Albertus Magnus, with the impositions which were practised upon the credulous, to the present time when the principle of a speaking machine had been developed by Mr Willis Van Helmont was one of the first to write upon the adaptation of the organs of voice to the articulation of the letters He considered that the letters of the alphabet constituted the order in which articulate sounds were naturally produced, by the structure of the tongue and the larynx , that when one letter is uttered the tongue is in the proper position for the pronunciation of the subsequent one Wheatstone gave a demonstration with a copy of a speaking machine which had been invented in Germany, the words 'mamma', papa', 'mother', 'father' and 'summer' being distinctly pronounced The instrument consisted of a pair of bellows, to which a tube was fixed and which ended in a bell, the aperture of which was regulated by the hand so as to produce the sounds

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Societies and Academies

DUBLIN

Royal Irish Academy, March 16 W. B MORTON : Vortex polygons A revision and completion of the classical investigation of J J. Thomson on the stability of the rotation of a set of equal straight vortex-filaments at the angular point of a regular polygon. It is found that the period of rotation is that also of the most rapid oscillations about steady motion, the shorter periods given in the former work for five and six vortices being spurious, and arising from an unjustifiable step in the analysis. The motion of seven vortices is on the border line between stability and instability, one of the oscillations having vanishing frequency, to the first order of approximation. *The modes of motion in each case are* examined in detail

PARIS

Academy of Sciences, March 18 (*C.R.*, 200, 993–1076) GEORGES CLAUDE : The campaign of the *Tunisie*. AUGUSTE LUMIÈRE and MLLE. SUZANNE SONNERY : The mode of action of suspensions of carbon introduced into the circulation Intravenous injections of carbon induce hyperleucocytosis, roughly doubling the proportion of white corpuscles SAMUEL EILENBERG : Invariance with respect to small transformations. CLAUDE CHEVALLEY : The definition of Betti groups of closed ensembles. GEORGES VALIRON The Borel directions of meromorph functions of zero order M. LAVRENTIEFF : A class of continued representations. CHARLES LEDOUX : A stroboscopic torsiometer for the determination of the power of a motopropulsive group of a ship. PIERRE SALET : The velocity of light deduced from measurements of stellar radial velocities. *The difference between the* velocity of light deduced by the spectroscopic method from stellar radial velocities and that of Michelson is not due to a systematic error depending on the hour angle in the star observations ANDRÉ GOUGENHEIM : The accuracy obtained in determinations of latitude by means of the prism astrolabe.

Loiseau : The rational mechanics of the Euclidian connexions and a necessary form of all physical laws. Pierre Jolibois · A new arrangement of the diffusion pump. Description, with diagram, of a combined Sprengel pump and mercury vapour pump Pierre Auger, Albert Rosenberg and François Bertein . The characters of two corpuscular components of the cosmic radiation Experiments confirming the view given in an earlier paper, that there are two groups of primary corpuscular cosmic rays, both of great energy, but absorbed differently by matter Marcus Francis and Tcheng-Da-Tchang The preparation of thin layers of uranium oxide, U_3O_8, by electrolysis Deposits of less than 0·2 mgm per square cm are adherent, even after ignition. Léonard Sosnowski The artificial radioactivity of bismuth The excited radioactivity was very weak, but its variation of intensity followed an exponential law The capture of a neutron by the bismuth nucleus is accompanied neither by emission of a proton nor by the emission of an α-particle Maurice de Broglie . Remarks on the preceding communication. Jean Perreu The tonometry of saline solutions Victor Henri and Pierre Angenot The ultra-violet absorption spectrum of pyridine Three frequencies, 600 cm $^{-1}$, 1,029 cm $^{-1}$ and 1,488 cm.$^{-1}$ are found in Raman, infra-red and ultra-violet spectra. Mlle Cecile Stora Contribution to the physico-chemical study of photo sensitive electrodes with colouring matters Jean J Trillat and M Paić The annealing of pure aluminium The results of an X-ray study of commercial (99 per cent) and refined (99·993 per cent) aluminium. Paul Laffitte and Pierre Grandadam : The nitride formation of some metals The production of nitride was studied by measuring the changes in electrical resistance of a wire heated in nitrogen or in ammonia M Lemarchands and Mlle D Saunier . The reaction of the metalloids on the basic oxides Study of the substance obtained by grinding iodine with mercuric oxide in a mortar its constitution is $HgOI_2$. Paul Job, Mme Marie Freymann and René Freymann : Absorption spectra in the near infra-red of organic and mineral derivatives of ammonia. Armand Marie de Ficquelmont : The action of ammonia on the tetramer of phosphorus bichloronitride. The final product is always phosphorus nitride, P_3N_5 P P Boudnikoff . The heat of hydration of mortars Jacques Parrod . The oxidation products of (*d*-arabino) tetrahydroxybutyl.4 imidazol by nitric acid Léon Palfray : Some new mineral salts of urea. Robert Levaillant : The action of methyl chlorsulphonate on methyl acetate : the action of dimethyl sulphate on acetyl chloride. Mlle. Simonne Caillère . The signification of the phenomenon of incandescence shown by certain antigorites. Valérien Agafonoff . Some considerations on the colloidal part of French soils Marcel Pichot : The imbibition and swelling of the clay of arable soil and their relations with the solids in rivers Daniel Barbier, Daniel Chalonge and Etienne Vassy : The effect of the temperature of the stratosphere on the spectrum of ozone Charles Fabry : Remarks on the preceding paper. St. Jonesco : Pollination in certain ephemeral flowers. René Leriche and René Fontaine Demonstration by aortography at the thorotrast of the vasodilating effect of peri-arterial sympathectomy. Analysis of this effect. Mlle. Jeanne Lévy : Experimental alcoholism. Cellular hypersensibility due to acidosis. James Basset, Eugène Wollman, Mme. Elisabeth Wollman and Michel A. Macheboeuf : Studies on the biological effects of ultra-pressures. The action of very high pressures on the bacteriophages of spores and on autolysins. Michel Weinberg and Jean Davesne . The antitoxic titre and anti-infectious power of therapeutic sera

LENINGRAD

Academy of Sciences (*C R* , 1, No 1 , 1935). M Lavrentjev Some properties of univalent functions O Zhitomirskij · Classification of cubic forms A Ivanov . Perturbations in the movement of the minor planet (122) Gerda during the period 1904–35, and the ephemeris of the planet for the opposition in 1935 B Numerov : The problem of the determination of the geoid on the basis of gravity observations S Rodionov, M Pavlova, N Rejnov, N Stupnikov and A. Juzefovich . The short ultra-violet in the solar spectrum N. Andrejev : Measurement of the amplitude of vibration by a finger O Leipunskij The steric factor in the equation of the rate of activated adsorption E. Brumberg : A new sensitive polariscope V Dubov Local tides of the Baltic Sea and their connexion with inundation at Leningrad F Loewinson-Lessing . Two kinds of correlation between the atomic numbers and atomic weights of chemical elements J. Kerkis Does the irradiation of the soma produce mutations in the germ cells ? M. Timofejeva Frost resistance of winter cereals in connexion with the phasic development and hardening of plants N Petinov · Methods of controlling the grain quality of irrigated wheats While watering by flooding reduces the protein content of grain, spraying increases both the amount of grain and its protein content. E Slastenko The *Scorpaena* of the Black Sea

VIENNA

Academy of Sciences, Feb 28 Margarete Hoffer Determination of the polonium content from salts of thick layers. Herbert Haberlandt, Berta Karlik and Karl Przibram . Fluorescence of fluorite (4) Detection of uranium in fluorites and low-temperature fluorescence After intense ignition, fluorites show a green uranium band, which serves in estimating the uranium content The nearer the fluorite is to acid eruptive rock, the more frequent and the more dominant is the yellowish-green fluorescence of the ytterbium. Varying relative concentrations of ytterbium and europium in fluorites from different sources are indicated. R. Brinckmann Comparative researches in the Gosau Basin of the north-eastern Alps Adolf Müller and Maurice Dorfman : Photochemical behaviour of pyridine, 2-benzylpyridine, papaverine and various derivatives When irradiated with a quartz lamp in the air, 2-benzylpyridine undergoes two main reactions In the short-wave ultra-violet, a yellow aldehydic compound is formed, the pyridine ring probably being ruptured In the long-wave ultra-violet, photo-oxidation to 2-benzoylpyridine and 1 . 2-di-α-pyridyl-1 . 2-diphenylethane occurs ; papaveraldine is formed similarly from papaverine F. Hess : Reply to Arthur Wagner's "Critical Remarks on the Daily Course of Cosmic Ultra-radiation". The reality of the daily course of ultra-violet radiation indicated earlier by Hess, Steinmaurer and Graziadei is confirmed Josef A. Priebsch : Statistical determination of the effect of barometric pressure on ultra-radiation. By a modification in the method of calculating, errors involved in the statistical method of ascertaining the air-pressure coefficient of ultra-radiation are taken into account. **Armin Dadieu** and **Hans Kopper**: The Raman spectrum of liquid deuterium chloride. This spectrum consists of a wide, diffuse band of low intensity and with a maximum at 2041 cm^{-1}. Under analogous conditions, ordinary liquid hydrogen chloride furnishes a band at 2822 cm^{-1} **Guido Machek** The action of aromatic hydroxy-sulphonic acids on hippuric acid (1). The interaction of hippuric acid and the three isomeric cresols, phenol and β-naphthol yields salt-like molecular compounds of the hydroxybenzene (or naphthol) with glycocoll (liberated from the hippuric acid) in equimolecular proportions. **Leopold Schmid** and **Charlotte Kemeny** Investigation on *Flores verbasci*. The identity of the acid found, together with the colouring matter crocetin, in these flowers with *n*-1 14-tetradecandicarboxylic acid is confirmed by the synthesis of the acid from sebacic acid, by way of decandiol **Hans Przibram** The life of the water-beetle, *Hydrocus piceus*, L. (Col Hydroph), without antennæ The feelers are not unconditionally necessary to the breathing of *Hydrocus* in water

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, May 5

British Museum (Natural History), at 3 and 4 30 —M A Phillips "Birds" *

Tuesday, May 7

University College, London, at 5 —Dr E W Fish "The Physiology of the Teeth" (succeeding lecture on May 14) *

Institution of Civil Engineers, at 6 —Prof. O T Jones · "Geophysics" (James Forrest Lecture)

Wednesday, May 8

Institute of Metals, at 8 —(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1) —Prof W L Bragg "Atomic Arrangements in Metals and Alloys" (Annual May Lecture)

Thursday, May 9

St Mary's Hospital, London, at 5 —Prof E. D. Adrian "The Electrical Activity of the Brain".*

King's College, London, at 5 30.—Hugh Braun "The Development of the Castle in England and Wales" (succeeding lectures on May 16, 23 and 30) *

Friday, May 10

Royal Institution, at 9 —Dr. C S. Myers "The Scientific Approach to Vocational Guidance".

Electrical Association for Women, May 8–11.—Annual Conference to be held in Manchester and Salford.

Margaret, Lady Moir . President.

Official Publications Received

Great Britain and Ireland

Reports of the Council and Auditors of the Zoological Society of London for the Year 1934, prepared for the Annual General Meeting to be held on Monday, April 29th, 1935 Pp. 103. (London Zoological Society.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 22 · Investigations on the Control of Seedling Diseases of Sugar Beet. By William Hughes. Pp. 205–212. (Dublin : Hodges, Figgis and Co. ; London Williams and Norgate, Ltd.) 6d.

Bristol Museum and Art Gallery. Publication 19 . Explanatory Guide to the Geological Relief Map of the Bristol District. By Prof S. H. Reynolds Second edition. Pp 24 (Bristol Bristol Museum and Art Gallery.) 3d

Imperial Agricultural Bureaux. Fifth Annual Report of the Executive Council, 1933–1934 Pp 51. (London H.M. Stationery Office.) 4s net

Agricultural Progress the Journal of the Agricultural Education Association Vol 12, 1935 Pp 204. (Cambridge · W. Heffer and Sons, Ltd) 5s net

Brussels Exhibition 1935 British Chemical Exhibit. Organised by the Association of British Chemical Manufacturers Pp 87 (London Association of British Chemical Manufacturers)

Other Countries

U S Department of Agriculture. Circular No 334 Characters Useful in distinguishing Larvæ of *Popillia japonica* and other introduced Scarabæidæ from Native Species By Robert J Sim. Pp 20 (Washington, D C Government Printing Office) 5 cents

Comptes rendus de la septième séance de la Commission Géodésique Baltique réunie à Léningrad et Moscou du 12 au 19 Septembre 1934. 1e partie · Procès-verbaux et rapports Rédigés par Ilmari Bonsdorff Pp. iii + 182 2e partie · Communications Rédigés par Ilmari Bonsdorff Pp ii + 429 (Helsinki Commission Géodésique Baltique)

Obras completas y Correspondencia cientifica de Florentino Ameghino Vol 14 Investigaciones de morfología filogenética en los molares superiores de los Ungulados Edicón Oficial ordenada por el Gobierno de la Provincia de Buenos Aires Dirigida por Alfredo J Torcelli Pp 619 + 271 plates (La Plata.)

Carnegie Endowment for International Peace Annual Report for 1934 of the Division of Intercourse and Education By Nicholas Murray Butler Pp 68 + 8 plates (Washington, D C , and New York . Carnegie Endowment for International Peace)

Field Museum of Natural History Report Series, Vol 10, No 2 Annual Report of the Director to the Board of Trustees for the Year 1934 (Publication 336) Pp 137–280 + plates 13–24 (Chicago Field Museum of Natural History) 1 dollar

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Protection of Aborigines in West Australia

ANOTHER chapter has been added to the annals, too often distressing, of the aborigines of Australia in the report on conditions in West Australia which is referred to elsewhere in this issue (p 798) The Commissioner, Mr H D. Moseley, to whom the investigation was entrusted in 1934, discloses a situation which in certain respects is sufficiently grave , but happily his statement does not endorse the allegations of callousness and brutality in the treatment of the aborigines to which currency has been given

For some time, public opinion in Australia has shown a slow but steady growth in the direction of a more rational and considered policy in the treatment of the aborigines The movement began with the efforts of the late Dr H Basedow some years ago to secure substantial reserves of land, upon which aborigines still living under tribal conditions might be ensured in their liberty to range over an area adequate for the exercise of their primitive economy as 'food-gatherers' in the technical sense of the term employed by the anthropologist Unfortunately this—in the modern view uneconomic—mode of livelihood demands a considerable stretch of undisturbed country for the support of even a small group of people, and although the policy of preserving land for the exclusive use of the native, from which white settlement is barred, of late years has been followed on the whole with consistency, constant vigilance has had to be exercised by anthropologists and others interested in the welfare of the black-fellow to protect him against those who have desired the development of the land for economic uses and to their own advantage. That these efforts have not always been entirely successful is suggested by recent representation to the authorities that the aborigines were in danger of suffering privation through being forced off their hunting grounds by encroachment on their land.

In many respects the aborigines of West Australia have been more fortunate than their fellows in other States. On the whole, conditions have favoured the survival of their tribal organisation to a greater degree than elsewhere except, perhaps, in the central area and in the Northern Territories. The growth of white settlement in West Australia until the opening of the gold fields in the latter part of the nineteenth century was slower and more sparse than in most of the other parts of Australia, and the development of the northern area, where the nearest approach to untouched tribal conditions still exists, was late The distinction to be drawn between conditions in the northern and southern areas of the State is clearly to be discerned in the report of the Commissioner, where there is a lamentable picture of degeneration as it occurs among the aborigines of the southern area owing to longer and closer contact with white civilisation. It is especially apparent in the pitiable situation of the half-caste, which has arisen out of the undesirable conditions attendant on the proximity of aboriginal camps to the towns

Partly as a consequence of this late development, the problem of the aboriginal in West Australia has been approached on the whole with a greater sense of responsibility and in a more enlightened spirit than would have been possible in an earlier day Policy has been inspired by a genuine, if not always well-directed, desire to secure the well-being of the blackfellow That policy has been applied for some time past through officials who not only had sympathy with the native point of view, but also had knowledge of aboriginal tradition and organisation The crux of the problem has been, and continues to be, the aboriginal spoiled by too close contact with white civilisation, who at best lives by casual employment, and on the fringe of the towns often will end by becoming a more or less permanent burden on the community

To admit that the system of aboriginal protection in West Australia is not without its merits is not necessarily to argue that it is beyond reproach A perusal of the report of the Commissioner on present conditions would do much to remove that illusion, even though there is a suggestion that friction between missionary and squatter may have been responsible for some of the more serious accusations which have been bandied about; while the denunciation of labour conditions on the stations as virtual slavery would appear to belong to that class of hysterical overstatement which seems inseparable from all agitation for reform. Yet, when all allowances are made, it would be difficult to frame stronger expressions of animadversion than certain sections of this report. This can be conveyed only imperfectly in a summary.

In carrying out his duties of investigation, Mr. Moseley wisely did not confine himself to the examination of witnesses, but travelled about the State to inspect conditions himself. In this way he covered some 14,000 miles within the year. On the whole, his report on conditions in the north cannot but be regarded as favourable. The 'bush' native, he agrees, is at his best when left alone, and he recommends that in order to ensure this, the lands at present in occupation by bush tribes should be secured to them as reserves, and that further reserves should be declared, to anticipate closer white settlement Nor does he find that conditions among the natives on the stations, whether privately owned as pastoral farms or Government-owned, are unfavourable Occupation suited to the character and capacities of the native is open to them in pastoral pursuits He criticises the Government stations, however, for not keeping the natives sufficiently fully employed

In these circumstances, Mr Moseley is by no means in favour of the policy of locating all aborigines on reserves Throughout the report he stresses the advantage, and indeed the necessity, of finding suitable occupation for the aborigines On the stations, they are already engaged in suitable pastoral pursuits, and the children receive a preliminary training for these pursuits in the natural order of things Removal to the reserves, even if an attempt were then made to bring them more under the influence of the code of white civilisation, as has been suggested, "would not react to their advantage" In another section of his report, while considering the proposal in connexion with the aborigines of the southern area, he points to the overcrowding of the reserves which such removal would entail

If Mr. Moseley finds little on which to comment in the social and economic condition of the aborigines of the north—even the so-called slavery, whereby no wages are paid, is shown to be beneficial to the native rather than an economic advantage for the farmer—the case is far otherwise when the question of health and provision of medical attention is under consideration. The lack of provision for early diagnosis and hospital treatment is made the subject of severe comment. In fairness, it must be pointed out that responsibility for the inadequacy of the measures for dealing with leprosy, which call for the most serious strictures, are not entirely those of the State, as the care of leprosy comes under the authority of the Federal Government—affording material for consideration by those who advocate that the entire responsibility for the aborigines should be handed over to Federal authority. Mr. Moseley offers certain suggestions for dealing with the provision of medical treatment; but he regards the question as one of such gravity as to warrant the appointment of a medical man to hold the office of district protector of the aborigines.

Stricture of the lack of proper medical attention and hospital accommodation is not confined to conditions in the northern area only, though there, owing to the conditions of settlement, it presents the more serious problem. In the southern area it is a problem which can be solved by the enlargement of existing hospital arrangements, although these, it may be mentioned, are also severely criticised, both for their character and their limited extent.

Apart from the medical question, the problems of the southern area are essentially different from those of the northern area—the Commissioner notes, with a surprise that is almost naïve, the relative unimportance of the half-breed element in the north. The grave problems of the south—and they are indeed grave—are the half-castes and persons of aboriginal descent, the character of the Government settlements, and the situation of aboriginal camps in proximity to the towns. Nothing could well be stronger than the criticisms which are levelled against existing conditions. They constitute a grave indictment of the methods of administration, and call for no further comment. Here Mr. Moseley recommends what is virtually a wholesale clearance and the provision for able-bodied aborigines and the half-castes of Government farm stations, which will allow of agricultural and horticultural allotments, and give facilities for training very much on the same lines as the provision which has been made in Queensland.

While conditions such as those censured at the Moore River settlement must be attributed to lack of supervision and as such chargeable to the administration, the report recognises that the system, and not the responsible official, the Chief Protector of the Aborigines, is to blame. The Chief Protector has been chained to his office at Perth, and it has not been possible for him to perform his proper function of travelling and inspection. Much of the work of his Department, it is admitted, has been highly successful; but it is pointed out that the system of honorary protectors has not 'functioned, except in the granting of permits for employment.

It is evident that if, and when, the changes, administrative and other, recommended in this report are brought into effect, the Department for the Protection of the Aborigines will be a vastly more costly undertaking than it is at present. To an outside view it certainly would appear that a duty which must necessarily entail a heavy expenditure to make it worth while at all, has suffered in performance from economy. In this connexion, perhaps, the relevant figures may be left to speak for themselves. Of all the States of the Australian Commonwealth, West Australia has by far the greatest number of aborigines under its control. They approach thirty thousand (29,021). Next come the Northern Territories (under Federal control) with 19,336, and Queensland, with 16,957. The lowest is South Australia with 3,407, and New South Wales comes next with 9,724. On the other hand, West Australia is proportionately the lowest in expenditure, her aboriginal administration costing £28,340 per annum as against Queensland, £41,128, New South Wales, £53,124 and South Australia, £23,000. While cost per head would be no fair criterion, owing to the difference in the conditions under which the natives live, for the cost of 'bush' natives is low and small numbers entail relatively heavy expense, yet when every allowance is made, the figure for West Australia seems far too low in comparison with that of other States. It would appear that undue exercise of economy has allowed the practice of the State to fall below the standard of modern policy in dealing with the aborigines.

Mr. Moseley's report is a valuable document. Its outstanding feature is its constructive character and its grasp of realities, sympathetic, but unclouded by sentiment. In this connexion, however, it must be recognised that it takes a very definite line that does not entirely coincide with the aim of those who have advocated a liberal policy in dealing with the Australian aboriginal. Only in part does it endorse the segregation of the blackfellow from white civilisation on reserves; where by contact with white civilisation native organisation has broken down, either in part, as on the stations, or has become wholly degenerate, as near towns and settlements, the measure suggested is occupation and training under supervision or protection along lines which, following present trends, eventually will make the aboriginal self-respecting and self-supporting. On no other condition does Mr. Moseley see in the degenerating blackfellow and the half-caste anything but a danger to the community. If his policy be adopted, it remains to be seen whether the difference in conditions in Australia will favour a course, which, eminently reasonable as it seems in itself, has not as yet proved an unqualified success when applied elsewhere.

Reviews

Sir Charles Parsons

Scientific Papers and Addresses of the Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S. Edited by the Hon. G. L. Parsons. With a Memoir by Lord Rayleigh, with Appendices. Pp. xxviii+260+8 plates. (Cambridge: At the University Press, 1934.) 15*s*. net.

THE foreword by Lady Parsons gives the *raison d'être* of this book; she did not live to see its publication. It is issued with "the hope of helping the interested reader to appreciate the genius, the perseverance and the indomitable courage of Sir Charles," she writes, and this it does completely; while the personal reminiscences of Lord Rayleigh give us a charming picture of a great inventor from many points of view. An appendix contains a complete list of Sir Charles's published papers from 1885 onwards, and in the volume are printed a number of these sufficient to illustrate the range of his activities and the development of his ideas.

The steam turbine and its story occupy the major part of the book. Sir Charles Parsons's first published utterance on the subject occurs in a discussion at the Institution of Civil Engineers on a paper on "High Speed Motors" by Gisbert Kapp in November 1885. The earliest paper printed in the volume is dated December 1887 and gives an account, read before the North-East Coast Institution of Engineers and Shipbuilders, of a turbine of early design applied to the working of dynamo electric machines. There is a gap until we come to 1897. The application of the compound steam turbine to the purpose of marine propulsion, a paper read, at the suggestion of Sir William White, to the Institution of Naval Architects, tells of the *Turbinia* and her trials during which a mean speed of 31·01 knots was obtained.

Law suits and difficulties over patents had caused delay; a cruel experience had taught Sir Charles that the path of the inventor is no smooth road; but the *Turbinia* was a great success and henceforth, with some setbacks it is true—his losses of the *Viper* and the *Cobra* in 1901, though in no way connected with the turbine machinery, were heavy blows—the tale is one of progress and marked success; the latest paper printed, an address in 1909 to Section G (Engineering) of the British Association meeting in South Africa, describes turbines of 150,000 kilowatts. The indicated horse-power of the *Turbinia* about thirty years earlier had been 1,576 horse-power.

The story, as we follow it in the inventor's own words, is of fascinating interest, and while in this part of the volume it relates mainly to the turbine, we come from time to time on remarks of much wider application. Thus in an address to the Institution of Junior Engineers of 1899, Parsons concludes thus: "It may be remarked that in the history of engineering progress the laws of natural selection generally operate in favour of those methods which are characterised by the greater simplicity or greater efficiency whether these advantages be great or small."

These were the methods Parsons ever followed until they led him to success. His address in 1904 to Section G of the British Association deals with invention. Generally, he writes, "what is usually called an invention is the work of many individuals each one adding something to the work of his predecessors", and then after an account of the internal combustion engine, he asks, "Could not this very valuable invention have been introduced in a much shorter time by more favouring circumstances", and his reply is that "a great deal might be done". As part of his answer he discusses a matter which for long occupied his attention, the exploration by means of a deep shaft of the lower depths of the earth. The means for securing in such a shaft a pressure and temperature at which man could work are considered and the estimate is reached that a shaft 12 miles deep would take 85 years to complete, that the temperature at the bottom would be 272° F. and the cost £5,000,000. The address concludes with the statement that the value to the world of the benefits due to the tools left by inventors as a heritage to the human race has on the average exceeded by ten thousand-fold the money spent on making and introducing the inventions.

The volume contains two or three addresses of special interest. In 1919, Parsons was president of the British Association meeting at Bournemouth. The year marked the centenary of the death of Watt and thus led to an interesting comparison between the turbine and Watt's engine, to which "consuming from five to seven pounds of coal per horse-power, mankind owes the greatest permanent advances in material welfare recorded in history". Engineering and the War occupies a large portion of the address, which concludes with a reference to the work of the Department of Scientific and Industrial Research constituted in 1915.

In his address to the Institute of Physics in 1924, Parsons again deals with the inventor. He states that at one period during the War, the Boards of Invention and Research received more than 2,000 inventions and suggestions a week, of which only a minute fraction of 1 per cent were in any way helpful, while scarcely any were of practical value—a result due to the lack of scientific knowledge and methods of thought among inventors

In 1893 Parsons carried out a number of experiments on carbon at high temperatures and under great pressures with the view of obtaining a dense form suitable for arc lamps and the filaments of incandescent lamps The experiments led to an attempt to produce diamonds, an account of these was given in a paper to the Royal Society in 1907, and the conclusion then reached was that in none of the experiments designed to melt or vaporise carbon under pressure has the residue contained more than a suspicion of black or transparent diamond The experiments were continued, and Sir Charles gave a detailed account of his work to the Royal Society in the Bakerian Lecture of 1918 It is a remarkable paper, giving details of a long series of experiments in which almost every conceivable combination of pressure and temperature was tried, but with almost entirely negative results The greatest pressures, estimated to reach momentarily about 300,000 atmospheres, were obtained by firing a 0 303 inch bullet from a rifle into a hole of the same diameter in a steel block partially filled with various substances containing carbon In two cases "a few crystals" were formed (probably from friction) The bullet had grazed the side of the hole, producing a small quantity of molten iron The results of all the experiments are given in an appendix, which is not printed in the volume under notice They are chiefly negative The few that were favourable were generally attributable to the presence of iron This appendix is a wonderful memento of Parsons's "genius, perseverance and indomitable courage". It covers 16 pages (small print) of the Royal Society *Transactions*, it is called an abridged schedule, but it contains a record of some 290 experiments of which about 25 are stated to have shown some indication of diamonds "A few crystals", "some crystals", "one crystal 0·5 mm long which burnt in oxygen", "several crystal plates very like diamond" are the words used to describe these few results In some 90 per cent of the experiments the result is "Nil", meaning no diamond formed

The volume concludes with an account of the auxelophone by Mr. Carnegie, an instrument for augmenting sounds used in 1906 by Sir Henry Wood in his orchestra, and some details of Parsons's work in improving optical glass

In these pages, we see Sir Charles as a great inventor; to realise the man we turn to Lord Rayleigh's delightful memoir. They met at a garden-party in Cambridge during the British Association meeting of 1904, and some six years later their friendship led to a visit to Parsons's home at Ray Lord Rayleigh gives an amusing description of his untidy study with a writing table in the window, from which Lady Parsons occasionally removed cigarette ends, burnt out matches, etc, no housemaid was allowed to touch it, in one corner a gorgeous casket presented to him when made a freeman of the city of Newcastle; on a table at the side a cage containing a white cockatoo, sometimes a trial to his visitors, never to its owner, on the table in the centre of the room a litter of books and papers, but no bookcase and no adequate collection of books of reference, either in the house or in his room at the works, a few simple tools, but no workshop

There is an instructive story from a Cambridge contemporary, a fellow oarsman in the Lady Margaret boat of 1878 One day after a training breakfast, he told the crew he had an engine which is going to run faster than any engine to-day. To the reply "Rot", he produced a paper model, and when he blew into it the wheels flew round, the oarsmen were not interested and to show their contempt put Parsons and his engine under the table, a foretaste of the reception the first turbine was to receive and of the struggles of its inventor Another story illustrates his treatment of a difficulty which threatened to be disastrous It was the morning on which the *Viper* was to run her official Admiralty trial After a preliminary run, the crew struck for higher wages Parsons knew his own mind, and the men walked off the ship He collected a casual crew from the quay, borrowed some men from the firm which had built the boilers and the hull, and with this scratch crew the *Viper* ran her trial and did 37 knots

Though 11th wrangler at Cambridge, in later life Parsons never used his mathematics to solve a problem When invited to listen to some analytical solution, he would say "I like something geometrical I never was very good at analysis and now I have forgotten all I knew".

There is much more of interest in these intimate reminiscences Like most inventors, Parsons was alive to the importance of maintaining a secret until properly protected, hence a bottle of some harmless preparation of carbon was labelled 'ARSENIC', and a simple wooden model of a propeller hidden behind his books He was usually inclined to be silent and listen to what others had to say to him, sometimes he would speak, and as when on one occasion, after discussing some question relating to engines with a naval officer, a chance acquaintance at the club, the latter afterwards inquired, "Who is that contradictious old gentleman? He seems to think he knows more about the engines of my ship than I do myself"

Parsons hated to be beaten Some of his friends, Lord Rayleigh among them, thought there was little prospect of success in the elaborate experiment on the diamond his reply when this view was put before him was "I think it ought to be tried " The trials were expensive Dr Stoney estimated that they had cost £30,000 Parsons's reply was, "We have now made a bit of money and deserve to have some fun". Within a few days of his death, he had dwelt on his hopes of having a shot at the 200-inch mirror for the proposed great telescope at Pasadena

Lord Rayleigh tells us that his purpose has been to bring before the readers of the volume the personality of one of the greatest figures in the engineering world of this or any other time For his successful picture he has well earned the congratulations and the thanks of his readers Our thanks too are due to the Hon G L Parsons for his skilful editing of this selection of the papers of his distinguished uncle R T G.

Manometric Methods in Biology

Manometric Methods as Applied to the Measurement of Cell Respiration and other Processes By Dr Malcolm Dixon Pp xii+122 (Cambridge: At the University Press, 1934) 5*s* net

MANOMETRIC methods have long been used in biology, and when one considers that the earliest specimens of the two principal types of instruments dealt with in the book under review were devised by Barcroft and Haldane so long ago as 1902 and 1908 respectively, it might perhaps appear inappropriate to call the manometric method an essentially new one. Only during the last decade, however, have manometers become so important in many different branches of medical and biological science. The reason for this, as Sir Frederick Gowland Hopkins points out in his foreword, is to be found in the fact that the method has in that time been especially developed for the study of the time course of chemical processes, in homogeneous media as well as in more complex systems containing cells or cell-associations. In many of the fundamental chemical reactions of living cells, such as respiration, assimilation of carbon dioxide or nitrogen and many fermentations, gas exchange takes place, in others it is possible to bring about such exchanges by suitable procedure, as for example, the liberation of carbon dioxide from media containing bicarbonate as a result of lactic acid formation in glycolysis

The main advantage of these methods for biological research is that many phenomena of cellular metabolism can be studied without necessarily interfering with life and growth; it is especially important that many of the fundamental chemical processes occurring in animal organs are kept intact in sections of tissue. The tissue slice method is one of the many improvements of technique initiated by O Warburg; but, independently of the development of the method in his laboratory, workers from the Cambridge School of Biochemistry, Dr Dixon among them, had used the Barcroft differential manometer for the study of reaction rates Much of the experience gained in this work has never before been published, and it is therefore appropriate that the detailed account of both the theory and the practical application of the differential manometer takes a prominent place in Dr Dixon's book

It is difficult to give a more fitting appreciation of the book than that expressed in Sir Frederick Gowland Hopkins' foreword, and it may therefore suffice here to state that it gives a complete survey of the principal types of instruments and methods as well as a critical assessment of their merits and shortcomings There is no doubt that the book will be of great help to all present and prospective users of manometric methods H B.

Antarctic Foraminifera

"Discovery" Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands Vol. 10 *Foraminifera*, Part 3: *The Falklands Sector of the Antarctic (excluding South Georgia)* By Arthur Earland Pp 208+10 plates (Cambridge At the University Press, 1934) 37*s* 6*d* net

THE third part of this great monograph on the Foraminifera collected by the Discovery expedition deals with the area called the Falklands sector of the Antarctic Ocean exclusive of the South Georgia waters It lies south of the convergence line where the cold Antarctic water meets the warmer water of the subantarctic area

It was shown in the first part of the monograph that in the Falkland Islands area, north of the convergence line, there are several species of Foraminifera that are characteristic of the Pacific ocean, and in the second part that in the shallow waters round South Georgia there is no evidence of this Pacific influence

In the Antarctic sector the Pacific species were more numerous than might have been expected and in addition to several new species, fully described in this part, there were thirteen species which seem to have a purely circumpolar distribution.

One of the most interesting results of this investigation is the discovery of a very well-marked difference between the foraminiferous fauna of the Bellingshausen Sea and the Weddell Sea. These two seas are separated by the long tongue of land, called Graham Land, which projects northwards in the direction of Cape Horn. If in the comparatively recent geological times there was a land barrier across what is now Drake Strait, this difference in the foraminiferous fauna between the two seas separated by Graham Land may be accounted for, and the absence of Pacific forms from the South Georgia seas may be due to the diversion of the drift northwards by Graham Land and the comparatively shallow waters immediately north of it.

These are only some of the general considerations which form a distinguishing feature of this important report, and it should prove to be of considerable interest to many workers in other fields of marine zoology as well as to systematists of the Foraminifera.

The third part of the report fully maintains the high standard of excellence set by those that have preceded it, as regards the detailed analysis of the dredgings, the description of the species and the very beautiful illustrations.

Short Notices

Tollens—Elsner Kurzes Handbuch der Kohlenhydrate. Vierte, völlig neubearbeitete Auflage, von Dr. Horst Elsner. Pp. xxii+627. (Leipzig: Johann Ambrosius Barth, 1935.) 39 gold marks.

DR. ELSNER has undertaken the formidable task of reviewing the literature on carbohydrates to the end of 1933, and compressing the material into one volume. This has involved the curtailment or omission of many important topics, such as the glycosides, the biochemical transformations of sugars and technical processes, all of which have been dealt with by experts in recent monographs. The number of compounds described is so great that relatively little space has been available for the critical examination of theories. Nevertheless, properties or reactions which are known to be of fundamental importance in the elucidation of molecular structure have been discussed in considerable detail, and the text has been amply supported by references to original papers at the foot of each page.

Among topics of theoretical interest which are briefly described are stereoisomerism and nomenclature, ring-chain tautomerism, enzyme action, the synthesis of monosaccharides and the investigation of molecular configuration. Monosaccharides occupy the largest section and among these *d*-glucose is naturally prominent. In discussing structural problems, the author stresses the importance of the brilliant studies in methylation by Howarth and his colleagues. Turning to the polysaccharides, it is pointed out that there is general agreement as to the nature and mode of linking of the units in the chain of cellulose. Chemical evidence is here supported by X-ray measurements. The actual length of the chain in the macro molecule is not so simple a problem to settle, and different methods give somewhat different results at present. From chemical evidence Haworth and Hirst have calculated that the chain contains between 100 and 200 glucose units. This result is in fair agreement with that of Stamm, which is based on measurements of the velocity of sedimentation in the ultra-centrifuge, and those of H. Mark and K. H. Meyer, derived from X-ray measurements, while Herzog's osmotic data point to rather higher values. On the other hand, Staudinger's viscosity determinations, which are less general in application and perhaps more empirical in character, generally give still higher values.

The volume is well printed and annotated and should prove to be a valuable work of reference. At the end will be found a useful chart showing clearly the configuration of the various aldoses and the corresponding alcohols and acids.

Air Ministry: Meteorological Office. The Meteorological Observer's Handbook, 1934 edition. (M.O. 191.) Pp. viii+152+32 plates. (London: H.M. Stationery Office, 1934.) 5s. net.

THE previous edition of this useful handbook appeared in 1926. In the present edition the most important change occurs in the section on clouds, which has been revised in the light of the new "International Atlas of Clouds and States of the Sky" published in 1932. There are also modifications relating to observations of the state of the ground and to the scale of velocity equivalents of the Beaufort numbers as derived from records of anemometers exposed at abnormal heights above the ground. Like the "Meteorological Glossary", the "Observer's Handbook" in its special function of giving instructions for the taking of routine observations, both instrumental and non-instrumental, at climatological stations is encyclopædic in scope. We are not sure that the various kinds of precipitated or deposited moisture are in every case so clearly defined as could be desired. Thus though it is implied that 'drizzle' is fine rain, that is, rain consisting of very small drops, and may be heavy, moderate or slight, there seems to be a tendency in official practice to look upon drizzle as a distinct species of precipitation from rain, instead of as one of many varieties of rain which it really is. Snow also may fall in fine 'drizzling' particles. Then surely the most obvious difference between hoar-frost and rime is that the latter, which is frozen fog-drip, collects copiously on leafless twigs and branches of trees.

As suggestions for improvements are asked for in the preface, we should like to recommend fuller and wider instructions for observing the sky and its portents In these days when official meteorology is becoming so intensively developed, scarcely enough attention is being paid to open-air or landscape meteorology We believe that even official forecasters will see the danger inherent in the growing attitude of mind typified by the countryman who, when asked what he thought about the weather, replied that he had not heard the 'wireless' L C W B

Automatic Protection of A C Circuits By G W Stubbings Pp. viii+293 (London Chapman and Hall, Ltd , 1934.) 15s net

THE subject of the automatic protection of electrical circuits and systems has grown to great importance, this being very largely due to the growth in size of transmission systems and distribution networks The present book discusses at some length the theory of protective transformers, relays and their interconnexion, and a great deal of useful information is given. The work is presented in a very clear, but not too mathematical a manner, plentifully illustrated with simple line diagrams

The chapter on symmetrical components is extremely valuable. The introduction of a vector operator which imparts rotation through 120° is, of course, a development of the original Steinmetz notation It is, however, necessary that the fundamental principles should be clearly presented, and in this connexion it is unfortunate that a loose statement should have crept in at the bottom of p 81 It is there stated that "the phase voltages, between lines and neutral of a three phase system . . . form a closed triangle" This is not generally true, as can be seen at once if the case be considered where there is a short-circuit between one line and the neutral With a little amplification the statement could be corrected

Further chapters on protection of electrical machinery, cables and transmission lines, and the testing and maintenance of protective gear follow, and a useful bibliography and glossary of terms are given

The work can be thoroughly recommended to all those whose work brings them into contact with the protection of A C circuits. P K

Reports of the Progress of Applied Chemistry Issued by the Society of Chemical Industry Vol 19, 1934. Pp. 840 (London: Society of Chemical Industry, 1935) 12s 6d ; to Members, 7s. 6d

THE publication of this annual volume of reports is an event which few chemists allow to pass unnoticed Indeed, it marks an annual opportunity, particularly valuable to those whose duties prevent frequent contact with colleagues working in other spheres and whose close perusal of current literature is necessarily confined to their own vocational interests, to bring up to date their general knowledge of progress in the principal branches of chemical industry. The twenty-six chapters comprising the reports for 1934 have been entrusted to authors whose competence to assess relative values and to make informed comment is unquestioned, and the abundance of references to original sources of information gives the book the status of a permanent work of reference. It is not easy to select any part as meriting exceptionally honourable mention , nevertheless, Dr E. Stedman should be congratulated on his detailed discussion of the chemistry of the hormones and vitamins, whilst the chapter on intermediates and colouring matters, contributed by Dr E H Rodd and Dr S Coffey, is a masterpiece of thoroughness and compression. The first report, entitled "General, Plant, and Machinery", is attractively written , the section on explosives covers the period 1933-34 A. A E

An Introduction to the Modern Theory of Valency By Dr J C Speakman Pp vi+157 (London . Edward Arnold and Co , 1935.) 4s 6d net

DR SPEAKMAN'S book is an unpretentious volume, in which he has been content to give his own impressions of modern valency theory, without necessarily indicating the sources of the views assimilated for this purpose The resulting blend is, however, on the whole well-balanced and satisfactory, and is presented in a clear and attractive form. Special interest attaches to a chapter of twelve pages on "The Application of Wave Mechanics to Valency Problems", since these conceptions are fundamental to all modern theories of valency The chapter is written in simple language and contains much that is suggestive It is a matter of regret to the reviewer that the scope of the book did not justify an extension of this chapter to include the explanation of quantum numbers and the interpretation of Pauli's exclusion principle on the basis of wave-mechanics , but such an exposition demands an advanced knowledge of quantum theory, which very few chemists possess, and it is therefore probable that it must be left to a chemically-minded physicist to interpret these conceptions to them T M L

Birds of Great Britain and their Natural History. By W P. Pycraft. Pp 206+17 plates (London: Williams and Norgate, Ltd , 1934.) 7s 6d. net.

To the student who wishes to identify the birds of the British Isles, this book has no message , indeed it mentions by name only a very small proportion of the birds of Britain, and in this respect its title is misleading. But it brings together and classifies from a natural history point of view many odd items of information difficult of access to the majority of amateur ornithologists, yet needful for an intelligent interest in the structures and habits of our birds. The treatment of the facts is suggestive and speculative, and while speculation appears to the reviewer to be sometimes hasty and information occasionally inaccurate, there is great merit in the way in which unsolved problems are openly laid upon the table. Works of this type are much needed, since they may suggest to the amateur naturalist lines along which he may still make valuable contributions to science, at a time when the niceties of the racial discrimination of British birds have almost barred him from a field where once he held his own.

The Approach to the Absolute Zero *

THERE is no upper limit to the temperatures which could conceivably be reached; in marked contrast to this, there is on the low temperature side a sharp boundary at − 273·1° C. —the absolute zero of temperature. The boiling point of the most volatile gas, helium, lies about 4° C. above this limit; by reducing the pressure over liquid helium, it is easy to reach a temperature of 1° K., whilst 0·7° K. has been attained by the use of extremely powerful pumps. The contrast between the ease with which a high temperature can be generated—an electric torch is an example—and the complicated apparatus necessary to obtain a low one, is striking. It is due essentially to the fact that when a substance is heated there is not only an increase in its energy, but also in the internal disorder among its particles. In illustration, there is complete disorder in a gas, whereas a substance cooled sufficiently to cause it to crystallise has its constituents arranged with a high degree of order. In all affairs, it is easier to decrease order than to increase it; it is highly improbable that shaking a tray containing a number of black and white balls would increase the regularity of their arrangement.

In the last example, the orderliness depends on one variable only; the possibility of attaining low temperatures depends on the fact that the orderliness among the molecules of real substances is governed by more than one variable. Consequently, orderliness introduced by the agency of a change in one variable, say, the volume, has its effect on the other variables, such as the temperature. From this point of view, a method commonly used for liquefying helium operates as follows: as the gas is compressed, the decrease in volume tends to increase the order, so that the disorder due to the heat motion has to increase; in other words, the temperature rises. The compressed gas is now cooled, which increases the total order again, and when it expands again, the resulting decrease in order due to volume must be compensated by an increase in the thermal orderliness, that is, by a fall in temperature.

In the practical application of this method, starting at moderate temperatures, the cooling effects obtained are quite small, owing largely to the overwhelming heat capacity of the container. At low temperatures this difficulty disappears, since, for example, at 12° K., 1 c.c. of helium gas at 100 atmospheres has the same heat capacity as 1 kgm. of copper.

Fig. 1 is a diagrammatic sketch of the actual apparatus used for liquefying helium and for reducing its temperature after liquefaction. The helium is contained in C, D being the liquid hydrogen bath, and the space S being evacuated. The vessel E can be filled with liquid helium through the tube T, and is of a shape suitable for applying a magnetic field to its contents. By lowering the pressure in E, the temperature can be brought down to about 2° K. The gas thermometer is represented by G.

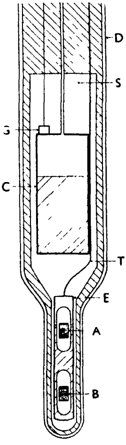

FIG. 1

At very low temperatures, the gas thermometer is impracticable and one other means of measuring temperatures is to utilise Curie's law, according to which the susceptibility of a paramagnetic substance is inversely proportional to its absolute temperature. This method has the great advantage that it increases in sensitivity as the temperature is lowered.

It has already been remarked that the lowest temperature reached by decreasing the temperature over liquid helium was about 0·7° K. No substantial progress is to be anticipated by this method, and we have to seek some other disordered systems than gases on which to operate. Such systems are to hand in the paramagnetic salts mentioned above. In them, there are elementary magnets which, owing to the thermal agitation, are directed at random. When a magnetic field is applied, the magnetic orderliness is increased, so that the thermal order decreases, that is, the temperature rises. If the substance is now cooled by contact with its surroundings, so as to increase the total order, and the field afterwards removed, order is transferred from the magnetic to the thermal mode, and the temperature falls again. This method was proposed by Debye and Giauque about ten years ago, and has been successfully used in recent years by Giauque, de Haas, and Kürti and Simon.

Iron ammonium alum, with a field of 14,000 gauss, gives by this method temperatures down

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* Substance of a discourse delivered at the Royal Institution by Dr. F. Simon on Friday, February 1.

to 0·04° K , whilst with potassium chromium alum, and the large magnet of the Leyden laboratory, de Haas has reached 0 015° K.

Insulation at these temperatures is an easy matter, since radiation becomes negligible, whilst the vacuum round the substance is very high on account of the low temperature itself This is illustrated forcibly in the accompanying table, which shows the vapour pressures of helium (the gas with the highest vapour pressure) at various temperatures

Vapour Pressures of Helium

T (°K)	p (mm)
1 0	$1\ 5 \times 10^{1}$
0 7	$3\ 2 \times 10^{3}$
0 5	$2\ 5 \times 10^{5}$
0 3	7×10^{10}
0 2	3×10^{15}
0 1	3×10^{31}
0·05	4×10^{62}
0 03	6×10^{103}

It is interesting to note that the temperatures obtained by the demagnetisation technique are below any found in Nature Even in inter-stellar space, radiation maintains a body at least 2° K above absolute zero

To examine the properties of other substances at these very low temperatures, a small pellet is made by mixing the substance to be examined with the paramagnetic salt By this means, several new supra-conductors have been discovered, though even at 0 05° K there are metals which do not show supra-conductivity Again, it immediately becomes evident if the specific heat of the admixed body is abnormal, and consequently gives an indication of any phenomena involving energy changes in this region

Finally, it must be emphasised that research in this low temperature region will be productive of fresh results , the effort to progress towards the absolute zero is not merely directed to the creation of fresh 'records' but to actual study of changes associated with energy increments of such magnitude that only in this region can they be observed

During the course of the lecture, the liquefaction of helium by the method explained above, of compressing the gas to 100 atmospheres, cooling it to 12° K with solid hydrogen and then allowing it to expand, was demonstrated The phenomenon of supra-conductivity in lead was shown at the temperature of the liquid helium, the current being produced and its existence shown by magnetic means

Norwich Meeting of the British Association

THE preliminary programme of the British Association meeting in Norwich on September 4–11 has now been issued The president, Prof W W Watts, announces the subject of his address as "Form, Drift, and Rhythm of the Continents" It would be difficult to conceive a title better capable of intriguing thoughtful laymen That continents possess form they will no doubt appreciate, but the ideas that continents should drift, and possess rhythm, ought to make them eager to learn It is to be hoped that it may be made easy for them to do so, for, to say truth, the Association in its endeavours in recent years to apply the advancement of science to the needs of its members, by reinforcing the voices of presidents through amplification, has been singularly ill-served as a rule

The building in which the address will be given is not yet settled, but the other rooms which will be in use by the Association are very conveniently placed In St. Andrew's Hall, formerly the fifteenth century church of a Dominican foundation, the business of the Reception Room will have a most imposing setting None of the section rooms is so much as half a mile from it , seven of them are immediately adjacent to it Norwich, once the visitor has learned the intricacies of its medieval streets, is unusually well provided with the type of accommodation demanded by the Association. As for the lodging of visiting members, the local committee, foreseeing some possibility of difficulty if members were left to make their own arrangements, offer to procure hotel or other accommodation for them, and indeed advise them not to communicate with hotels direct In this connexion it should be remembered that those who wish to combine a holiday with the meeting, and are not too closely tied by the business of the Association, have unusual opportunity to obtain pleasurable accommodation elsewhere than in the city The preliminary programme includes a long list of hotels (with prices) at Bacton, Caister, Cromer, Gorleston, Yarmouth, Holt, Lowestoft, Mundesley, Overstrand, Scole, Sheringham, West Runton and Wroxham, as well as in Norwich itself

The two customary evening discourses are announced That by Dr S J Davies will deal with Diesel engines in relation to coastwise shipping—a subject of topical interest (as it may be surprising to some to know), for the number of coastwise trading vessels which make their way up-river to Norwich has increased of late years. The other discourse will enter a field of still wider public interest . Dr C S Myers will speak on the help of psychology in the choice of a career

The programme announces a distinguished series of addresses by the sectional presidents Dr F. W Aston will speak in Section A on the story of isotopes. The address in Section B, by Prof. W. N Haworth, will introduce a discussion on the molecular structure of carbohydrates Prof G Hickling in the geological section will deal with some aspects of coal research Prof Balfour-Browne's address to Section D will be on the species problem The geographical section will follow its president, Prof F Debenham, to the polar regions Prof J G Smith will give the address in Section F on economic nationalism and foreign trade Mr J S Wilson's address to the engineers will be on the stability of structures In view of the regretted indisposition of Sir Cyril Fox, who was to have presided over Section H, the Association is fortunate indeed to have enlisted the services of Sir Arthur Smith Woodward, who, as it happens, has not previously presided over that Section , he will address it on recent progress in the study of early man. The address to the physiological section will be given by Prof P T. Herring on the pituitary body and the diencephalon , that to Section J (Psychology) by Dr Ll Wynn Jones on personality and age , and Section K (Botany) will hear Mr F T Brooks on some aspects of plant pathology Dr. A W Pickard-Cambridge's address to Section L (Education) will deal with education and freedom, and Dr J A Venn will speak to the agricultural section on the financial and economic results of State control in agriculture

It is well known that last year, in preparation for the Aberdeen meeting, the Council of the Association issued to the organising sectional committees a reasoned statement inviting their special attention to subjects bearing upon the relations between science and the welfare of the community Good effect was given to this request, and the results were favourable in respect of the additional public interest aroused by the meeting, while the daily and non-technical Press showed its appreciation of the choice of material provided for it by noticeably avoiding trivialities of its own creation. This year the Council reminded the committees of its previous memorandum, and brought these considerations to their notice , and already there is no lack of subjects of public interest in the Norwich programme. The Association is to make striking use of its mechanism for joint sectional meetings in bringing together engineers and psychologists to discuss the application of science to traffic problems Among other subjects which may be instanced in this connexion are those of noise and of lubrication in Section A ; Section D will find itself near enough to the east coast to continue its practical interest in the herring , Section E will consider local town-planning and land utilisation. Section F has its usual array of important economic problems for discussion, and will also deal with the chronology of the world crisis, on which a committee of the Association will shortly publish a full report Hearing and aids to hearing will be considered by the Sections of Physiology (I) and Psychology (J) , the place of psychology in the training of teachers by Sections J and L (Education) Section L will stage demonstrations illustrating physical education Section M (Agriculture) will base a discussion on the results of State control in agriculture upon the address of its president, Dr Venn

The local scientific interests of East Anglia are great and varied, as is very well known The geologists will be within reach of classic ground for glacial geology, and none will willingly miss the unusually valuable opportunity offered by a few days' tour of coastal and inland sections in Norfolk from Hunstanton to Cromer and Bacton, under the guidance of Prof P. G. H. Boswell, immediately before the meeting. Geologists and anthropologists together will inevitably discuss early man in East Anglia Botanists and agriculturists will interest themselves in land utilisation in the unique area of the Breck country, and East Anglia offers Section M an unusual variety of agricultural activities for its study The list of proposed excursions offers evidence of all these interests and more besides

In Section D (Zoology) there will be a commemoration of the centenary of the landing of Darwin in the Galapagos Islands (which falls a few days after the meeting) and the birth of the Darwinian hypothesis of the origin of species For the Association, as the custodian of Darwin's home at Downe, such an occasion is appropriate for remembrance Moreover, there is in this subject a throw-back, so to say, to the last meeting of the Association at Norwich, in 1868 ; for J. D. Hooker was the president of the Association then, and had much to say of Darwin, while in Section D the Rev M J Berkeley as president paid high tribute to him, though the voice of another clerical speaker was still uplifted in doubt, and associated the varieties of forms and species with "laws of nature inscrutable to us".

An evening reception by the Lord Mayor and Lady Mayoress (Mr. and Mrs P W Jewson) is announced to take place in the Castle Museum, and a statelier setting could scarcely be found elsewhere H M Lieutenant for Norfolk, Mr Russell J Colman, and Mrs Colman, will give a garden-party in the beautiful grounds of Crown Point.

The Royal Academy Exhibition

IT is always of interest to the student of natural science to see the impression which the objects of his study produce upon the artistic eye In respect of the range of nature study at the Royal Academy there is, however, a lamentable falling off in the matter of natural history With the exception of Mr Peter Scott's "Barnacle Geese in April" (210) there is scarcely anything of note, and the almost total absence of studies of big game, notably of the great carnivora, is very disappointing Yet the material is not lacking, for there is a remarkably fine exhibition of contemporary big game pictures in a neighbouring gallery, not "mere transcripts of the objects of Natural History" but true artistic compositions

Landscape, however, continues to be well represented There is a large number of pleasing pictures of English scenes in which architecture provides the focal feature amidst natural surroundings In the verdant landscape of the English plain a village church or a distant cathedral provides the artist with the massive and formal element which is lacking in a country from which the harder rocks are absent Again, in the hilly landscapes we find studies such as that by Mr Stanley Royle of "Mont Orgueil Castle, Jersey" (265), in which an architectural feature crowning an eminence develops the rocky forms to a pitch of steepness and a regularity of symmetry towards which Nature seems to strive but never quite attains Such examples of artistic treatment provide a valuable lesson for the scientific observer, for the artistic outlook is more in accordance with the natural faculties of the eye than that which results from classifying objects by their physical qualities

Among the most pleasing illustrations of the combination of architectural and natural features are those of bridges, with massive piers and arches spanning smoothly flowing water In "A Welsh Bridge" (189) by Mr Oliver Hall, the combination is enhanced by a rocky background which harmonises with the massive masonry This picture brings home very forcibly the need for scheduling such structures as ancient monuments for preservation, a lesson emphasised by Mr Charles Cundall's beautiful picture of a sad event, "The Demolition of Waterloo Bridge" (447)

In the illustration of the seasons, the Academy will greatly miss the late Mr J Farquharson's snow studies, of which, however, the present exhibition contains one small example, "In Glen Garry" (558)

In natural scenery the mode of illumination is scarcely less important than the features themselves, and we are indebted to Mr J Olsson for his beautiful study of moonlight—"Moonlit Surf Irish Coast" (297) There is also one very fine study made in the deepening darkness of the night, "Santa Maria della Salute, Venice" (532), the diploma work of Mr Richard Sickert

Mr A E Kelly's "Mount Sefton, New Zealand" (669) is one of the few pictures of the scenery of distant lands The want of studies of tropical scenery will be particularly felt by those who can recall the magnificent sunset effects in the equatorial belt

Among the portraits are several of personal interest to the scientific community Mr Francis Dodd's "The Lord Rutherford of Nelson, O M" (1207) is a strong drawing of a strong face Mrs Dodgson's drawing of the late Prof H H Turner (1253) renders admirably the quiet humour of the eyes beneath a thoughtful brow Mr Augustus John has portraits of Lord Conway of Allington (284) and Prof J C McLennan (288) Mr George Harcourt gives us a portrait of Colonel R E B Crompton (368) which reveals a vigorous personality, and in Sir James Crichton-Browne by Mr Oswald Birley (314) we see a fine rendering of calm and thoughtful reminiscence.

VAUGHAN CORNISH

The Royal Jubilee

ADDRESSES FROM THE ROYAL SOCIETIES OF LONDON AND EDINBURGH

IN addition to the messages of devotion and loyalty sent to the King from civic and governing authorities of the Empire at home and overseas, expressing congratulations to His Majesty upon the celebration of the silver jubilee of his accession, addresses were presented by a number of representative scientific societies The addresses submitted by the Royal Societies of London and Edinburgh are reprinted below.

TO THE KING'S MOST EXCELLENT MAJESTY

May it please Your Majesty,

We, Your loyal and dutiful subjects, the President, Council and Fellows of the Royal Society, humbly beg leave to offer Your Majesty, the beloved patron of our Society, our respectful congratulations upon the completion of the twenty-fifth year of Your Majesty's reign.

The Royal Society of London since its foundation by King Charles the Second, has continued, under the illustrious patronage of each of Your Majesty's predecessors, to devote itself to the Promotion of Natural Knowledge, for which it was founded. During Your Majesty's reign, the advance of Science has exercised an ever increasing influence on human thought, and, in its practical applications, on the material conditions of man's life and activities. The Royal Society is proud to think that, with Your Majesty's continued patronage and approval, it has remained the centre for the recognition and promotion of the work of Your Majesty's subjects for the Advancement of Science throughout Your great Empire.

The Royal Society accordingly claims the proud privilege of being permitted to offer this loyal tribute of esteem to Your Majesty, on behalf of men of Science, not only in the Mother Country, but also throughout the Empire. It is offered in the earnest hope that Your Majesty, with Her Most Gracious Majesty the Queen, may long continue to reign over Your devoted and loyal subjects.

On behalf of the Council and Fellows of the Royal Society.

TO THE KING'S MOST EXCELLENT MAJESTY

May it please Your Majesty,

We of the Royal Society of Edinburgh bring to Your Majesty and to Her Most Gracious Majesty the Queen our humble and hearty congratulations on the happy issue of the five-and-twenty years during which Your Majesty has ruled over a loyal and devoted people.

These years of Your Majesty's reign mark a great epoch in History. War has shaken the world and changed the lives and thoughts and circumstances of men. But the devotion of the people to Your Majesty's Throne and Person has deepened and strengthened through all the changes and tumults of the age.

In this Royal Society the Natural and Physical Sciences are our daily occupation and task. Never have these Sciences flourished more than under Your Majesty's protection nor have they ever been more diligently applied to the service and advantage of mankind. Now for the first time in all the world men go their daily journeys above the clouds. All nations and languages send speech and music through the air; and Your Majesty's voice is grown familiar in Your people's ears even to the ends of the earth throughout Your world-wide Empire and Dominions.

And that Your Majesty may long be spared in health and wealth to live and reign this Society will Ever Pray.

Obituary

SIR JOHN ROSE BRADFORD, BART., K.C.M.G., C.B., C.B.E., F.R.S.

THE death of Sir John Rose Bradford, on April 7, after some months of increasing disability, will be deeply regretted in many scientific circles. Born in London on May 7, 1863, as the son of Abraham Rose Bradford, a naval surgeon, he was educated at University College School, University College, and University College Hospital, London, and had a brilliant career as a student, published physiological papers before he became qualified medically, and was specially interested in biology. His papers, however, were mainly physiological, and covered a wide field: on the electrical phenomena associated with secretion, on the innervation of the blood vessels; and particularly on the renal function, which he later extended to the subject of uræmia and disease. He probably hesitated about his life's work, whether strictly scientific work or medicine, for he was elected George Henry Lewes student in physiology in 1888, his predecessors being C. S. Roy (1879), L. C. Wooldridge (1882), and C. S. Sherrington (1884), and his immediate successors G. N. Stewart and E. H. Hankin jointly (1889). The decision was made when he accepted accelerated appointment as assistant physician to University College Hospital. His physiological researches gained him the fellowship in 1894 of the Royal Society, of which he was later secretary (1908–15). He thus, like his teacher, Sydney Ringer, combined the attitude of an all-round biologist with that of a practising physician.

At the Royal College of Physicians of London, Sir John was elected a fellow in 1897, gave the Goulstonian lectures on the pathology of the kidneys (1904), the Croonian lectures on Bright's disease and its varieties (1920), the Lumleian lectures on the clinical experience of a physician during the campaign in France and Flanders in 1914–19, and the Harveian oration (1926) on the debt of medicine to the experimental method of Harvey, which may be read as supplementary, and as showing the other side of the shield, to the debt of science to medicine, the subject of Sir Archibald Garrod's Harveian oration of 1924.

Though a general physician, as shown in his Lumleian lectures, Sir John was best known for his work on kidney disease; he wrote standard articles in the second edition (1908) of the "System of Medicine" (Allbutt and Rolleston) on the general pathology of the renal functions and on nephritis, and a special form of nephritis became known as "Rose Bradford's kidneys". In the same "System" he also gave the accounts of diabetes insipidus and gout, the latter being a revision of the original article by Sir William Roberts, whose niece he married in 1899. He brought out a small work "Clinical Lectures on Nephritis" (1898), but, though he had plenty of material, he never, from the number of other activities, had time or perhaps the inclination to write the treatise he could have done so well.

Among Sir John's many official appointments were that of professor-superintendent of the Brown Institution, Wandsworth, in his comparatively early life; member of the Mosley Commission (1904) to study educational methods in the United States of North America, for which he reported on the relations of hospitals to medical schools, clinical laboratories, and the teaching of medical pathology, senior medical adviser to the Colonial Office, the Medical Department of the Admiralty, and the Grocers' Company, chairman of University College Committee, senator of the University of London, president of the London and Counties Medical Protection Society, and a member or chairman of numerous committees Most conscientious, unobtrusively modest and endowed with a marvellous memory, he was an ideal chairman, and nowhere was this better shown than when president of the Royal College of Physicians of London (1926–31). It may well be said of him as a man that he earned "honour, love, obedience, troops of friends"

HUMPHRY ROLLESTON.

WE regret to announce the following deaths

Prof Auguste Marie, professor of microbiology in the Institut Pasteur, Paris, known for his work on rabies, cancer and tetanus, on March 30, aged seventy years

Mr J Milton Offord, president of the Quekett Microscopical Club, on May 4, aged seventy-four years

News and Views

The Royal Jubilee Broadcast

THE birth and development of modern radio broadcasting are not least among the items of progress in our civilisation, which have taken place during the twenty-five year period the termination of which was commemorated last Monday by the Royal Jubilee celebrations An excellent example of the present possibilities of broadcasting technique was provided on this occasion by the special programme from the B B C stations, which enabled listeners in all parts of the Empire to visualise the scene in London, including the crowds, decorations and the Royal procession, and to participate in the thanksgiving service held in St Paul's Cathedral The issue of the *Radio Times* of May 3 contains an illustrated description by the Outside Broadcast Director of the B B C of the arrangements which were made to carry out this programme Special microphones, with local control points, were erected at Temple Bar, Ludgate Circus and on the front of St Paul's Cathedral, from which was given a commentary on the Royal procession as it approached St Paul's, while in the Cathedral itself, seventeen microphone circuits were provided for the adequate handling of the thanksgiving service. The suitable mixing of the various portions of the programme received along the total of twenty-seven circuits was carried out by one man, who was situated in the temporary control room erected over one of the vestries in the north-east corner of the Cathedral. This control room was connected to Broadcasting House by six outgoing circuits, two of which were utilised by a foreign commentator

IT says much for the foresight with which the arrangements were made and for the thoroughness with which each person concerned carried out his work, that the programme was accomplished without a fault of any description. The whole network of interconnecting cables was entirely underground and was provided by Post Office engineers, at no point inside or outside St Paul's were there any visible signs of broadcasting As a broadcast of sound effects, interspersed with brief commentaries, the programme was satisfactory Much, however, was inevitably left to the imagination in order to visualise the glamour and splendour of the scene which was being portrayed Is it too much to hope that by the next occasion when a similar ceremony is to be broadcast, the sound picture will be supplemented by a vision programme, perhaps even in full natural colour ?

Association of British Chemical Manufacturers

JUBILEES are occasions of rejoicing and congratulation, but they provide us also with opportunities for taking stock both of our national resources and of the use we are making of them ; so that when, after due examination and consideration, the celebrations are followed by renewed resolutions and by more fully informed and co-operative effort, they can fairly claim to have made a contribution of more than passing value to our national progress. Many organisations, national and sectional; political, ecclesiastical and industrial, philanthropic and learned societies, and indeed societies representing every phase of corporate life, will in 1935 be concerned to view with a critical eye their progress throughout the years of His Majesty's reign. In so far as they can show that their attempts to make the world a better place to live in have been honest, sensible and attended by a reasonable measure of success, they will receive a meed of applause ; in so far as they discover how better to carry out the purposes for which they were brought into existence, they will equally merit the approval of sympathisers. The year 1935 is one in which chemical organisations in Great Britain will take decisions of exceptional significance They have long been considering how they can more adequately serve their science and more effectively promote its application for the benefit and prosperity of the community. Proposals which are now under consideration have been put forward with that end in view. One of the organisations concerned, the Association of British Chemical Manufacturers, has recently published a brief survey of its work since its formation in 1916.

THE Association of British Chemical Manufacturers, which now has a membership roll of 117 firms representing a capital of more than £200,000,000, originated from the proposals of a committee representing the Chemical Society, the Society of Dyers and Colourists, and the Society of Chemical Industry, called at the suggestion of the first-named to consider the best methods of promoting co-operation between British chemical manufacturers. Additional objects served by the Association are: to provide British chemical industry with a medium for the expression of its views; to further technical organisation and promote industrial research; to facilitate the development and extension of British industries by keeping in touch with progress in chemical knowledge and practice; and to encourage closer co-operation between chemical manufacturers and the various universities and technical colleges. These desirable objects have been steadily borne in mind by the Association, the annual reports of which show a long record of achievement, and it has been prominently associated with all movements of importance since its formation. From its early days, the Association has maintained a service to keep members informed of the import and other statistics essential to their work, to keep them apprised of all directions in which new manufactures are needed, and yet at the same time to prevent useless overlapping by unnecessary duplication of effort. The Association is closely concerned with questions of safety in chemical works, with matters arising out of the Import Duties Act, with negotiations leading to new commercial treaties with foreign countries, with the incidence of acts such as the Dyestuffs Act and the Patents and Designs Act, with transport and with exhibitions. The monthly summary of information on chemical trade can be purchased by non-members.

Jubilee Exhibition at the Science Museum

To mark the occasion of His Majesty's Silver Jubilee, a pictorial exhibit illustrating the more outstanding inventions and conspicuous developments of the past twenty-five years has been arranged at the Science Museum, South Kensington. This exhibition was opened to the public on May 1 and will remain on view during the whole of the month. The main advances in the pure sciences, astronomy, mathematics, physics, chemistry, meteorology and geophysics are illustrated, together with their more important applications; for example, photographs are shown of the planet Pluto (which was discovered in 1930), modern methods of upper air investigations, radio-gramophones, 'talking pictures' equipment, infra-red photography and modern methods of prospecting. Of special interest is the series of photographs showing the rapid advances which have recently been made in our knowledge of the constitution of the atom, and the structure of the atomic nucleus. Progress of chemical industry is shown to include many important developments such as the low-temperature carbonisation of coal, the manufacture of insulin, artificial silk and plastic products; while in the case of glass manufacture, reference is made to the improvements resulting from the introduction of machine processes and the influence on the glass industry of the widespread use of the motor-car. Among other subjects represented may be mentioned the development of aircraft, ships, locomotives, motor-vehicles, steam turbines, oil and marine engines, while the advances in electrical power and communication are illustrated by modern electric power stations, automatic telephones, radio communication and television.

Award of Kelvin Medal to Sir Ambrose Fleming

THE Kelvin Medal of the Institution of Civil Engineers, which is awarded triennially as a mark of distinction in engineering work or investigation of the kinds with which Lord Kelvin was especially identified, was presented to Sir Ambrose Fleming by Sir Kingsley Wood, Postmaster-General, on May 7. Referring to our dependence on the universities for the inception of new scientific methods and scientific knowledge, Sir Kingsley said that thanks are due to Sir Ambrose not only for his own contributions, but also for the inspiration he has given to generations of students, which have spread over the world in ever widening circles like the wireless waves themselves. Sir Ambrose was one of those pioneers in the science of radio, who worked under both physical and financial difficulties, and yet succeeded in placing at our disposal a means of communication of thought, sound and vision. Broadcasting may well be one of the greatest factors in drawing together the nations of the world. Sir Kingsley said that mass production in research produces results, but at a relatively higher cost than the research of inspired and gifted individuals, which has hitherto characterised the majority of the investigations carried out in Great Britain.

Viruses and Heterogenesis

THE definition and nature of life have been favourite subjects for ancient and modern discussion. Sir Henry Dale, armed with many recent exact data, stated in the Huxley Memorial Lecture on "Viruses and Heterogenesis", delivered at the Imperial College of Science on May 2 (London: Macmillan and Co., Ltd. 1*s*. net), the dilemma which confronts those who attempt to decide whether all the viruses which cause disease are self-propagating micro-organisms or whether some of them do not originate from the tissues of the host. Admitting that their minute size is perhaps the most important obstacle to accepting the smallest viruses as frankly living, he pointed out that there is an unbroken series from a virus of about the same size as the smallest bacteria with a diameter of 750 mμ to the virus of poliomyelitis estimated at 10 mμ, which approaches the size of a protein molecule; the diameter of a molecule of egg-albumin has been calculated as 4·33 mμ (1 mμ = one millionth of a millimetre). The long category of viruses has several characters in common, making it very difficult to draw an arbitrary line at a certain size as criterion for separating two classes of entirely different natures

SIR HENRY referred to Huxley's discussion of biogenesis and abiogenesis, and to the recurring claims for the origin of life from dead matter, including the 'spontaneous generation' of worms, maggots and bacteria, and the repeated victories of the advocates of biogenesis He stated his personal opinion that the similar claim that viruses have their origin by heterogenesis in the tissues of the host would in the future be disproved and that the doctrine that like breeds like would triumph in this field also Sir Henry emphasised the fact that viruses are obligatory parasites and suggested that the minute filterable particles are only a stage in the life of the infective agent, which might be able to reconstitute larger and more complete forms inhabiting the cells of the host where they cannot now be recognised or their size determined He propounded the view that our theoretical problem is not to determine the lowest limit of size compatible with the minimum required for a living reproductive cellular unit, but to determine what is the minimal portion of such a unit which might be adequate for its reconstitution under favourable conditions.

Royal Institution: Annual Meeting

MAY 1 was the day of the annual meeting at the Royal Institution, when the members received the report of their committee of visitors on the state of the Institution during the year 1934, and when the election of officers took place in accordance with the time honoured procedure The three scrutineers were sent to watch the three balloting glasses during the half-hour that the ballot must remain open, at the end of the time they marched out to the private room appointed for the counting of the votes; and in due course they returned, to report to the meeting the names of the officers, managers and visitors elected for the year 1935–36 The president is to be the Right Hon. Lord Eustace Percy, the treasurer, Sir Robert Robertson; the secretary, Major Charles E. S. Phillips, new managers are Prof E. N da C Andrade, Sir Frederick Berryman, Prof A Fowler, Sir Richard Paget, Prof. A O. Rankine, Dr G. C Simpson, Mr. W J Tennant and Mr James Whitehead. The visitors report testified to increased membership, to improved attendance at the lectures and to a year of varied activities in the Institution The accounts show a financial position which cannot but be gratifying to the members and to their treasurer, Sir Robert Robertson, who has had charge of the finances since 1929, one of the most eventful and at times anxious periods in the Institution's history. The report of the Davy Faraday Research Laboratory records valuable progress during the year in the researches, largely on the structure of organic molecules, directed by Sir William Bragg. In the unavoidable absence of the president, Lord Eustace Percy, the meeting was conducted by the honorary secretary, Major Phillips; and it was remarkable for the felicitous terms of a speech in which the thanks of the members were given to the president for his services during the past year by Sir James Crichton-Browne, of whom the evidence of *Who's Who*, that he is now in his ninety-fifth year, is difficult to credit.

Atomic Arrangement in Metals and Alloys

PROF W L BRAGG, in the twenty-fifth annual May Lecture before the Institute of Metals on May 8, dealt with the inner structure, or atomic arrangement, of metals and alloys In general, when one metal is alloyed into another a series of phases appears Metal *A* dissolves a certain amount of metal *B* with a gradual alteration in properties as the proportion of *B* increases At a certain composition, a limit is reached, and for greater amounts of metal *B* a new phase appears as separate crystals of quite different properties mixed with the first phase Regions of single and double phase alternate as the composition varies from pure *A* to pure *B* These phases are the nearest approach in an alloy system to the chemical compounds formed by combining elements. X ray analysis has shown that each phase has its own definite pattern, such as a cubical array with atoms at corners and centres, or at corners and centres of faces The pattern changes from phase to phase One of the most striking generalisations about alloy patterns to which X-ray analysis has led us is the empirical Hume-Rothery rule, which states that the ratio of free electrons to atoms in a structure is the same for alloys with the same pattern. H Jones has recently shown how the alloy pattern affects the binding energy of these free electrons, and so has given a reason for this rule Another point brought out by the X-ray analysis is that the method of arrangement of the atom amongst the positions of the phase pattern can be varied widely The phase pattern is an entity apart from the way the atoms are distributed, in marked contrast to ordinary chemical compounds The study of the movements of the atoms amongst the positions, as affected by heat treatment, can be made the basis of a very interesting theory; at high temperatures the atoms are shuffled up in a random way, while at low temperatures they sort themselves out into a regular alternation The importance of this work is that it provides a basis for the chemistry of compounds formed between metals.

A National Statistical Service

THE establishment in Great Britain of a special statistical council comprised of business men, bankers, economists and members of the general public charged with the task of instituting a National Statistical Service was recommended by Mr Roy Glenday in opening a discussion on "The Use and Misuse of Economic Statistics" before the Royal Statistical Society on April 16. This new body would not itself collect statistics, but would devote its energies to co-ordinating the statistical work now being performed by Government departments, private bodies and individuals. Mr. Glenday pointed out that international trade has reached a crisis in its fortunes since the 'white' populations are rapidly approaching stagnation—that of Great Britain is actually on the eve of a decline—yet we have no means of measuring the industrial and commercial changes which this entails No organisation has been evolved to collect the statistics and other information which it is imperative to possess, and instead we are continuing to press forward with reorganisation schemes in housing, education and transport at home and to expand food and raw material supplies overseas as if world populations are destined to go on expanding at the old rate and with their age distribution unchanged The fundamental statistical facts and trends in regard to our economic life should become as much part of the common stock of ideas on which all act, as are certain of the fundamental facts of physics and chemistry

Economics of Progress

THE James Seth Memorial Lecture at the University of Edinburgh was delivered on April 26 by Mr Roy Glenday, economic adviser to the Federation of British Industries, who took as his subject "The Economic Consequences of Progress" There is a limit, he said, beyond which it is unhealthy to allow growth to proceed even in a community which takes special care not to overstep the frontiers of its own territory Conflict will still inevitably arise in the process of growing, under the pressure of congestion between the members of the different groups or subdivisions into which the community of necessity splits its territory and occupations No matter what may be the basic plan of subdivision adopted, there is a limit to the size of economic structure which can be erected on it with safety The United Kingdom, however, still possesses enormous resources, and the solution Mr Glenday favours is the one which accepts present tendencies as both reasonable and inevitable. They should be encouraged by promoting a flow of migrants from Great Britain, not for the purpose of developing the land and country-side of the Dominions and Colonies but to enlarge their industries and towns Given supplies of cheap capital, there are no insuperable obstacles to a redistribution of population between the over-populated Mother country and the under-populated Dominions overseas. This would be as much to their advantage as to ours In Canada, for example, the railways could serve a population three times its present size

Guide to National Collections

AMONG the numerous suggestions which have been put forward of means whereby the public might be stimulated to visit in greater numbers the museums and national collections in London, that of a general guide covering all the collections has been one of the most attractive It has been pointed out that few, outside those who are technically or professionally interested, know where to find exhibits which will illustrate subjects on which they desire to be better informed, while even among the learned and scientific public, not many could without hesitation state off-hand the range and purpose of each unit in the series A "Brief Guide to the National Museums and Galleries of London" (H M. Stationery Office, pp. 106. 6*d* net) has now been issued in accordance with a recommendation of the Standing Commission on Museums and Galleries in the hope, as expressed by Lord d'Abernon, the chairman, in a prefatory note, that "this guide, giving in compendious form the salient facts of interest concerning each of the Institutions, may stimulate public interest, both at home and abroad, in the unrivalled resources of the National Collections" It is not intended to supersede individual guides and handbooks, but to supplement them by giving briefly within a single cover information relating to the origin, purpose, range and arrangement of each, together with much useful and practical information, such as how to get there, time of opening and closing, charge for admission, if any, and the like Especially helpful is a series of street-maps, showing the approaches The information is clear, direct and comprehensive and there are some excellent illustrations Experience will show whether the information is given in a form which will attract those for whom it is intended Should the demand justify, it will be revised annually Copies may be obtained at H M Stationery Office sale branches or through any bookseller, as well as at the museums

University of London Buildings

MR T LL HUMBERSTONE sends us a copy of a letter he has sent to the Clerk of the London County Council relating to the provision of an open space on part of the site of the new buildings of the University of London at Bloomsbury He informs us that since his election as a member of the Holborn Borough Council in November last, he has found that an undertaking was given by the University to the Council and also to the London County Council that the University would "preserve a garden area with trees and grass equal in size to, but not necessarily identical in location with, that now existing in Torrington Square gardens". It appeared after inquiries made by Mr Humberstone that this undertaking was not carried out by the layout of the buildings Representations were therefore made, with the result that a new design and layout have been prepared, providing approximately an acre of additional open space in the form of three bays on the Malet Street frontage, giving this façade a crenelated form Mr Humberstone is the author of a valuable historical work on "University Reform in London" and contributed to NATURE of July 9, 1932, a long article on the development of the University and the design of the new Buildings.

British Oil from Coal

THE first train load of 100,000 gallons of oil made by low-temperature carbonisation from British coal went to the new plant of Imperial Chemical Industries, Ltd. at Billingham from the Barugh (Yorks) works of Low Temperature Carbonisation Ltd on April 26 The train, which was drawn by two locomotives, consisted of 34 tanks of 3,000 gallons each and weighed nearly 1,000 tons gross. On arrival at Billingham the oil, which is made from coal by the coalite process, is being submitted to hydrogenation and converted into about 100,000 gallons of petrol This is the first time that a bulk consignment of oil obtained by low-temperature carbonisation has been treated by a hydrogenation plant in Great Britain Tests carried out by Imperial Chemical Industries, Ltd, and H M Fuel Research Board show that this oil is particularly suitable for conversion into petrol by hydrogenation, and the event constitutes a notable achievement in the history of the coal and coal oil industry in Great Britain

The B.B.C *Annual*

THE *B.B.C Annual* for 1935 (London B B C 2*s* 6*d*) is the successor to the *B B C Year Book* for 1934 This Year Book, after a fairly successful career, has been discontinued The first section of the *Annual* gives a history of the Corporation's programme policy for the last five years The second section is the Corporation's report to the listeners of Great Britain A report is also given of the activities of the Empire service We are told that the object is not merely to give a recital of past programmes remembered or forgotten, but to explain and make comments on them Old problems have to be reconsidered and new problems are always arising So a new section is started called the 'forum', which is to be a market place for the expression of ideas by authors, who are wholly free and solely responsible for what they write, and is not a pulpit for making pronouncements It contains some interesting articles discussing amongst other subjects international broadcasting, free speech, music and radio drama. There is also an excellent short obituary notice of the late Mr J H Whitley, who devoted himself during the last years of his life to guiding most successfully the progress of this great national corporation

Dorothy Temple Cross Research Fellowships

THE Dorothy Temple Cross research fellowships in tuberculosis for the academic year 1935–36 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1, 1935 The object of these fellowships is to give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms" Candidates must be British subjects The fellowships will preferably be awarded to candidates who wish to make their studies or inquiries outside the borders of Great Britain They will be awarded for one year as a rule, but in special cases may be renewed The value of the fellowships awarded will depend in each case upon the standing and qualifications of the candidate, but will not be less than £350 per annum, payable monthly in advance. Travelling and some incidental expenses will be paid in addition. It may also be possible to award a senior fellowship of considerably greater value to a specially well-qualified candidate wishing to undertake an intensive study of some particular problem of tuberculosis at a chosen centre of work in another country Further particulars and forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

Leaflets on Disease of Fruit Trees

THE Ministry of Agriculture has recently issued Collection No. 1 of Leaflets on Fungus and other Diseases of Fruit Trees, price 1*s* 6*d* net This collection contains a copy of each of the leaflets on the subject at present issued by the Ministry, and is bound up in portfolio form so that when a new leaflet or a revised edition of an old one is published an insertion or substitution can readily be made Sectional vol 1, which contained the same leaflets in a permanently bound form is, therefore, superseded, as it is hoped that the new arrangement will prove of greater convenience. Those who desire to receive a copy of each new or revised leaflet as it is issued, in order to keep their portfolio up to date, may do so on payment of a nominal annual registration fee. Full particulars concerning this matter may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S W 1.

Cultivation of Soft Fruits

OWING to the imposition of import duties, soft-fruit growers in Great Britain have been able to find a satisfactory market for home-grown fruit during the past two seasons. The issue of a second edition of Bulletin No 4, "Soft Fruits", by the Ministry of Agriculture (London . H M S O. 1*s*. net) will, therefore, be particularly welcomed as it will enable the grower to make the fullest use of his protected position. The principal fruits dealt with in the bulletin remain as before, namely, strawberries, gooseberries, currants, loganberries, raspberries, figs and melons, though the subject matter has been considerably revised Sections on the cultivation of blackberries and dewberries have, however, been included in the new edition, owing to their increasing popularity. The cultivation of nuts is now omitted, as it is hoped to issue fuller information on nut culture as a separate bulletin

New Zealand Scenery

THE active steps taken by the New Zealand Government to preserve the original scenery of the Dominion are noted in the report on scenery preservation for the year ending March 1934. During the year, more than thirty new reserves were announced. They varied in size from small historic sites to areas of several hundred acres, the largest being about 9,000 acres in the Canterbury district, where a great area of beech bush has been set aside The total area of scenic reserves in New Zealand is now about a thousand square miles, divided into about as many different parts. The Act of 1908 under which such area can be dedicated to public care has now been amended to allow of any landowner applying to have his land declared a private reserve. This will help to maintain the scenic amenities of New Zealand.

The North-East Passage

SINCE Baron A. E. Nordenskiöld in the *Vega* made the North-East Passage in 1878–79, other ships have followed the same route, but it was not until 1932 that the journey was made in one season. In that year Capt. O. J. Schmidt took the ice-breaker *Sibeniakov* from Archangel to Vladivostok. It is now reported by Science Service that in 1934 the ice-breaker *Theodor Lütke*, commanded by Capt. Nikolaev, went from Vladivostok to Murmansk in eighty-three days. It should, however, be noted that heavy ice was encountered, and that the passage would have been impossible for a less powerful vessel. These achievements hold out little prospect for an ordinary unprotected trading vessel making use of the route for through passages.

Study of Malnutrition

A PUBLIC meeting, organised by the Committee against Malnutrition, will be held at the Conway Hall, Red Lion Square, London, W.C.1, on Thursday, May 16, at 8 p.m., to consider the health and nutrition of women and children in Great Britain. The chair will be taken by Prof. V. H. Mottram, and Miss Eleanor Rathbone, M.P., Dr. Janet Vaughan, and Prof. Marrack will be among the speakers. Tickets at 1*s*. each can be obtained from the Honorary Secretary, Mr. F. le Gros Clark, 190 Eagle Street, Holborn, W.C.1. The Committee against Malnutrition, which is a non-party organisation and has been in existence for a little more than a year, was established to obtain information respecting under-nourishment among families of unemployed and low-paid workers, and to co-ordinate efforts towards securing adequate nourishment for all. It publishes a bi-monthly bulletin, and organises propaganda on the subject. The annual subscription is 5*s*.

Announcements

THE King has been graciously pleased to command that the African Society shall henceforth be known as "The Royal African Society".

DR. WALLACE RUDDELL AYKROYD has been appointed by the governing body of the Indian Research Fund Association to the post of director of nutritional research under that Association.

A MEETING, followed by a discussion, will be held by the British Science Guild in association with the Engineers' Study Circle on Economics, on Thursday, May 16 at 5.30 p.m. in the Lecture Theatre of the Institution of Civil Engineers, Great George Street, S.W.1, when a report on schemes and proposals for economic and social reforms will be presented by Lieut.-Col. J. V. Delahaye. Tickets (for which there is no charge) are obtainable on application to the Secretary of the British Science Guild, 6 John Street, Adelphi, W.C.2.

THE North East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne, will celebrate the attainment of its jubilee by a series of meetings to be held on July 16–19, in Newcastle-on-Tyne. The celebrations will open with a reception at Armstrong College. On July 17 there will be a meeting to confer honorary fellowships, after which three papers will be read dealing with developments in ship construction during the past fifty years. On July 18 papers on marine engine construction, including turbines, reciprocating steam engines, boilers and heavy oil engines, and on recent progress in electrical and general engineering, are to be read, and on the following day Sir Westcott Abell will deliver a citizens' lecture on "Ships through the Ages".

WE regret that in the article on "Canadian Water Power Developments in 1934", in our issue of April 27, p. 642, it was stated that the investment represented by the present development is estimated at 1,743,000 dollars. This should read 1,743,000,000 dollars.

"CATTLE IN THE TROPICS" is the title of a booklet by Prof. Cecil Wood of the Imperial College of Tropical Agriculture, Trinidad (Government Printing Office, Port of Spain, 1934). It gives much useful information on the species and breeds of cattle suited to tropical conditions, their utilisation as draught animals and for meat and milk production, harnessing, feeding and general care, breeding and improvement. Sections are also devoted to their health and the diseases which affect them, and to the organisation of the industry.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of physiology in University College, Dundee (University of St. Andrews)—The Secretary (May 17). A temporary assistant engineer in the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (May 17). Chemists for the War Department chemist, Woolwich Arsenal—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (May 18). A secretary to the Advisory Council for Technical Education in South Wales and Monmouthshire—The Advisory Council, County Hall, Cardiff (May 18). A teacher of mechanical engineering and a teacher of electrical engineering in the Schools of Technology, Art and Commerce, Oxford—The Secretary for Education, Education Office, George Street, Oxford (May 20). An animal husbandry expert under the Imperial Council of Agricultural Research, India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 25). A lecturer in mathematics in the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1 (May 31). An assistant professor of science in the Indian Institute of Science, Bangalore—The Director (June 1). An assistant inspector of ancient monuments for Wales—The Establishment Officer, H.M. Office of Works, Westminster, London, S.W.1 (June 3). An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (June 10).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 794

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Relation of the Posterior Lobe of the Pituitary Gland to Anæmia and to Blood Formation

IT has been shown (Dodds, Noble and Smith[1], Dodds and Noble[2]) that it is possible to prepare an extract of the posterior lobe of the pituitary gland which, when injected subcutaneously or intravenously into animals, will cause an intensive hæmorrhagic lesión of the acid-bearing area of the stomach, from which the animals usually recover completely. Chronic ulcers may also be produced

During the course of study of the biological properties of this extract, further interesting facts have been observed If rabbits be injected subcutaneously with 150 mgm of the acetone picric acid extract of the posterior lobe of the pituitary, or alternatively with 40 c c of standard B P pituitary extract, a number of them develop a definite severe macrocytic anæmia The following table shows the typical hæmatological picture produced by this treatment

Rabbit No 363 ♂ 2 0 kilo				
Time	W B C	R B C (Million)	Hæmoglobin gm per 100 c c	Reticulocytes
				Per cent
	10,400	6 15	13 9	0 50
	9,800	5 95	13 9	0 75
Injection	20 c c B P	Pituitrin s	ubcutaneously	
1 day	11,600	6 00	13 6	2 00
2 days	8,600	5 45	12 3	0 10
3 ,,	12,000	5 95	11 8	0 50
5 ,,	15,400	3 10	8 4	8 00
6 ,,	9,800	2 35	7 5	17 00
8 ,,	9,600	2 88	7 5	21 00
9 ,,	13,400	2 36	6 8	24 00
10 ,,	9,800	3·03	7 0	20 00
12 ,,	8,800	2 83	7 6	9 00

The anæmia appears quite suddenly on the fourth to fifth day, the red blood count frequently being as low as one million cells per c mm A marked leucocytosis, up to 50,000 white cells per c.mm., is often associated. The hæmoglobin falls proportionally less than the red blood count A reticulocyte response commences on the fifth to sixth day and usually continues for seven to eight, reaching a peak about the ninth day. Reticulocyte counts up to 50 per cent have been observed. Examination of the blood smear shows the red cells to be well filled with hæmoglobin. Anisocytosis is present to a marked degree. Many large macrocytes and an occasional microcyte are seen. Poikilocytosis is slight Nucleated red cells have been observed. Platelets appear normal Leucocytes are mainly of the multi-nuclear type.

A series of control experiments have shown that hæmorrhage occurring from gastric lesions is not sufficient to explain these changes. Also control extracts of other tissues have not given any response on injection. If the animal be killed there are definite changes in the spleen, such as hæmorrhagic infarcts. The bone-marrow appears to show signs of hyperplasia The secretion of bile is greatly increased, as shown by a visible gross excess in intestines and faeces

So far as we are aware, this is the first time these changes have been produced by an extract of a normal gland The interpretation of these results is at present obscure The possibility arises that the control of blood destruction by the reticulo-endothelial system may be vested outside the system itself and may reside in the posterior lobe of the pituitary gland The reticulocyte response may be secondary to the anæmia, or alternatively may be due to the effect of the extract of the posterior lobe of the pituitary on the stomach causing it to produce an excess of the intrinsic factor, which in its turn acts upon the bone-marrow Intensive investigations are being conducted into these points at the present time

We wish to thank Dr L E. H Whitby for kindly examining our data and for his opinion on the blood picture

E C DODDS
R. L NOBLE

Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W 1
April 23

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[1] Dodds, E C, Noble, R L, and Smith, E R, *Lancet*, **2**, 918, 1934

[2] Dodds, E C, Noble, R L, *J Soc Chem Ind*, **53**, 1934 *Chemistry and Industry*, p 1026

The Contractile Factors of the Chromosome Micelle

IN a recent article in these columns[1] and in a paper presented to the Royal Microscopical Society on February 20, 1935[2], I put forward a model of a chromosome as an aggregate of polypeptide protamine molecules in association with nucleic acid It is unfortunate that data of a physico-chemical nature by means of which this hypothesis can be tested and rendered more precise are at present very meagre. It is, therefore, specially important to make the fullest use of such facts as are available, and in particular of those relating to the variable geometrical configurations of chromosomes, which are of the highest degree of delicacy and reliability[3,4] These are of particular importance in view of the recent work on the giant chromosomes in the salivary glands of *Drosophila*, *Chironomus* and *Sciara*[5]. I have, therefore, undertaken a systematic survey of these data and wish, in this preliminary announcement, to direct the attention of cytologists to the various contractile factors which the chromosome micelle may be expected to possess.

(1) The intramolecular or intermolecular contractile factors which depend upon electrostatic (salt-forming) attractions between basic and acidic ionised groups, belonging to the same[6] or different molecules.

These factors have already proved important in the case of keratin[7].

(2) The intermolecular contractile factor due to a variation in the number of ionised groups belonging to single molecules. This factor, which has not yet made its appearance in the literature of protein chemistry, is nevertheless an obvious possibility The number of ionised groups possessed by a nucleic acid molecule[8] varies considerably with pH The chromosome micelle—a protamine nucleate aggregate[9]—will therefore be capable of strikingly different configurations for different pH values, the nearer the pH approaches to the isoelectric point of the protamine nucleate the greater being the degree of contraction In view of the differential density of nucleic acid along the length of the chromosome, differential condensation (heteropycnosis)[4] is naturally to be expected This type of contractile factor also offers a simple interpretation of the results lately obtained by Kuwada and Darlington with ammonia vapour and with acetic and nitric acid[3]

(3) The intramolecular contractile factor as exemplified by keratin[7] In the case of keratin a contractile factor of 2 in particular has been attributed to intramolecular folds of the nature of linked pseudo diketo piperazine rings Evidently there may be other and more considerable degrees of contraction if the rings in question are formed not by two consecutive amino acid residues but by a run of 3, 6, 7, 10, 11, . . ., $4n - 2$, $4n - 1$ residues The first of these, yielding a contractile factor rather greater than 8/3, may be the explanation of the contractile factor of about 3 recently announced for myosin films[10] I now suggest that the chromosome micelle, evidently less stable than myosin and considerably less stable than keratin, will prove capable of a grosser type of folding, which will yield a far higher factor than the 2 of hair and the 3 of myosin

(4) The intramolecular contractile factors due to the sharing of an electron by the ketonic oxygen and the hydrogen atom belonging respectively to the carbon and nitrogen atoms in the backbone of a protamine molecule[11].

(5) The macroscopic 'twizzling' factor as exemplified by keratin fibres[12]. This contractile factor is of quite different type from the three preceding ones It is 'macroscopic' in the sense that it is a property not of individual molecules but of the micelle as a whole.

D. M. WRINCH

Mathematical Institute,
Oxford.
April 6.

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[1] NATURE, 134, 978, December 22, 1934

[2] "Chromosomes and their Structure" (In course of publication in the *J. Roy Micro Soc*)

[3] C D. Darlington, "Recent Advances in Cytology" London, 1932. Y Kuwada and T. Nakamura, *Mem Coll. Sci., Kyoto*, 9, 129–139, 1933 Y. Kuwada and T Nakamura, *ibid*, 9, 343–366, 1934 N Shinke, *ibid*, 9, 367–392, 1934 P. Ch. Koller and C D Darlington, *J Genet*, 29, 159–173, 1934.

[4] C. D. Darlington, *Cytologia*, 4, 229–240, 1933

[5] T. S. Painter, *J. Hered.*, 25, 465–476, 1934 C W Metz and E H Gay, *Proc Nat. Acad. Sci.*, 20, 617–621, 1934 R L King and H W Beams, *J Morph*, 56, 577–588; 1934 H J. Muller and A Prokofieva, *Comptes Rendus de l'Acad des Sciences de l'U R S S*, 4, 74–83, October 11, 1934. P Ch Koller, NATURE, 135, 69, January 12, 1935.

[6] Reference should be made to the literature of the 'zwitterion', specially to L J. Harris, *Biochem. J*, 24, 1080–1097; 1930.

[7] W. T. Astbury and H J. Woods, *Phil. Trans Roy. Soc*, A, 232, 333–394; 1933. W. T. Astbury, "Fundamentals of Fibre Structure". Oxford, 1933

[8] P. A. Levene and L. W. Bass, "Nucleic Acids", New York, 1932.

[9] D. Jordan Lloyd, *J. Int. Soc. of Leather Trades' Chemists*, 245–258; 1933.

[10] W. T. Astbury, NATURE, 135, 95, Jan. 19, 1935

[11] D. Jordan Lloyd, *Biol. Rev.*, 7, 254–278; 1932.

[12] A. Stanberry and B. Byerley, *J. Text Inst*, 295T, 1934.

α-Tracks in Presence of Strong γ-Radiation

IN investigations of nuclear transformations, it is sometimes desirable to be able to observe α-particles (or protons) in the presence of strong γ-radiation. This has already been successfully accomplished by means of an ionisation chamber connected up to a valve-amplifier and oscillograph (as in the investigations of Chadwick and Goldhaber[1] on the photo-disintegration of heavy hydrogen)

It may be of interest that, under suitable conditions, it is also possible to observe α-particles in the presence of strong γ-radiation by the Wilson cloud method The accompanying photograph (Fig 1) shows the tracks of α-particles from polonium deposited on the outside of the brass cylinder A, in the presence of γ-rays from a 25 mgm emanation tube placed inside A

FIG 1

The best conditions appear to be obtained with hydrogen in the chamber, at an initial pressure of about 40 cm mercury, and a high expansion ratio somewhat above 1 4 Under these conditions, about 60 per cent of the α-tracks observed in the absence of γ-radiation are still observed when a source of about 25 mgm is placed in A The conditions become rapidly worse if the strength of the source is increased much above 30 mgm and this appears to be about the maximum unfiltered emanation source that can be placed inside the chamber without destroying the cloud tracks of α-particles

About five hundred photographs were taken with the cylinder A covered with beryllium, and a 20–30 mgm. emanation source inside A, in order to investigate further the disintegration of beryllium by γ-rays, observed some time ago by Szilard and Chalmers[2]. No α-tracks were observed. Assuming that tracks of range R cm. in air are actually produced, this means that the cross-section for the photo-disintegration of a Be nucleus is less than about $5 \times 10^{-30} R^{-1}$ cm^2

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[1] NATURE, 134, 237, 1934

[2] NATURE, 134, 494, 1934

The Spectral Selective Photo-Electric Effect

ZENER has recently[1] discussed Fowler's theory[2] of the spectral selective photo-electric effect, and concludes that it is incapable of explaining the observed order of magnitude of the emitted current. Inasmuch as a direct calculation[3] of the photo-electric emission from a pure metal yields a spectral distribution curve differing only slightly from typical experimental curves for selective emitters, except as regards order of magnitude, the author considers Zener is right in stressing this last point as the main feature to be explained by a successful theory. Nevertheless, Zener's objection is not sufficient to dispose of Fowler's theory.

Fowler suggested that the surface potential variation of a selective emitter would be ideally of the form shown (Fig 1), having an intermediate hollow between metal and vacuum; and he showed further that the boundary transmission coefficient for such a field would have a maximum for energies for which standing waves could form in the hollow Zener objects to this that such a boundary transmission coefficient would lower the emission in general, but leave it unaltered at the selective maximum The further objection could be raised, that since the transparency level would be in use for a relatively wide frequency range, the spectral sensitivity curve would show quite a broad selectivity band, instead of the observed sharp maximum.

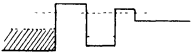

FIG 1

Both these objections, however, depend upon the fallacious argument that the emission from a metal with such a boundary field will be obtained essentially by multiplying the emission from a simple barrier by the appropriate boundary transmission coefficient The fallacy is as follows If the Schrödinger equation is set up for an electron in the boundary field (Fig 1), and solved for bound states, it is found that for those energies for which standing waves could form in the hollow, the electron density is very strongly concentrated therein Electrons in these states behave very similarly to atomic electrons, and give a correspondingly large transition probability The result is that, in spite of the smallness of the boundary transmission coefficient, the emission is on the whole large, while a steep maximum occurs for the combination frequency between the critical states forming standing waves in the hollow Experimental spectral distribution curves thus seem to be well reproduced by the theory.

If Fowler's theory is to be criticised, it must be on account of the predicted normal velocity distribution function This has two maxima, corresponding to the states forming standing waves in the surface, and the relative position of the maxima depends upon the frequency of the incident light Clear experimental evidence on this point would be of the greatest interest

Details of the calculation will be published elsewhere

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[1] C. Zener, *Phys. Rev*, 47, 15, 1935.

[2] R. H Fowler, *Proc Roy Soc*, A, 128, 123, 1930

[3] G Wentzel, "Sommerfeld Festschrift", 79, 1928 H Fröhlich, *Ann Phys.*, 7, 100, 1930. I. Tamm and S. Schubin, *Z Phys*, 68, 97, 1931. A. Sommerfeld and H Bethe, "Geiger-Scheel Handbuch der Physik", 2nd ed., 24/2, 468, 1933 K. Mitchell, *Proc Roy Soc*, A, 146, 442, 1934

A Rapid Practical Method of Demagnetisation involving High Frequency*

THE impossibility of demagnetising loosely packed or unrestrained particles of such material as that described previously in these columns[1] and the difficulty in demagnetising some of the new magnet steels prompted experiments which have produced a rapid method for substantially complete demagnetisation of all ferromagnetic substances

In direct opposition to the generally recommended procedure of using slow reversals and slow reduction of magnetic fields, it has been found that very rapid reversals of the field polarity and rapid reduction of the field strength are much more effective for the demagnetisation of material with high coercive force, especially when in a state of fine division In fact, the partially reduced hæmatite powder described in the previous note may now be conveniently demagnetised for the first time

The condition for effective demagnetisation may be brought about inside a solenoid by passing a damped oscillating discharge, or a series of such discharges, through the solenoid windings An 'induction furnace' used with a 3-kva high-frequency converter operates in this way but furnishes much more power than necessary Economically operated units have been built in which a direct current passing through solenoid windings has been repeatedly interrupted by a rotary make-and-break switch, across the gap of which a condenser had been connected The current, the number of turns in the solenoid, and the capacity of the condenser were regulated so as to give practically instantaneous demagnetisation of a substance without undue loss of power, a sufficiently accurate balance of capacity against inductance being obtained when a spark rather than an arc was produced on breaking the circuit. The speed of the switch was sufficient to ensure at least one complete oscillatory discharge to take place while the material was passing through the solenoid

A logical explanation of the effectiveness of this method for treating powders may be furnished by the supposition that the rate of magnetic field reversal is greater than that to which the poles of the magnetic substance can conform, thus permitting the particles to be caught in a more favourable position for demagnetisation than if time were permitted for their orientation in the prevailing magnetic field The fleeting high peak amperage of the damped oscillations, and internal shocks caused by the effect of high-frequency discharge, may also be contributing factors

This new H F method is applicable to any case where demagnetisation is desired It has been of considerable assistance in the laboratory in conjunction with the determination of the magnetic properties of powders, it is recommended for use in routine laboratory testing of bars or rods of iron and steel, and it may prove to be almost indispensable when the new magnet steels with coercive forces of 500–900 or more are encountered. The method can also be adapted to the commercial removal of permanent magnetism from minerals to permit better separation in processes involving magnetic concentration of ores

A literature search following the observations recorded above has revealed the fact that although a demagnetising effect by damped, oscillating, H F magnetic fields was noted by Henry and afterwards studied by Rayleigh, Rutherford, Marconi and others, none of the investigators seems to have realised the relation of this theoretical work to practical demagnetisation.

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United States Bureau of Mines
Feb. 5

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[1] Gottschalk, V H, and Davis, C W, "A Magnetic Material of High Coercive Force", NATURE, 132, 513, Sept 30, 1933

Variations in Interference Colours on Copper and Steel

THE high values of the refractive index of copper and iron make it probable that only slight changes of colour would be observed on varying the angle of incidence of the light. With burnished metal surfaces, changes of larger magnitude than expected (giving $\mu = 2{\cdot}4$ for copper oxide and $\mu = 1{\cdot}8$ for iron oxide) were observed with angles of incidence up to 78°, together with strong scattering of the complimentary colours At larger angles of incidence general reflection predominated, and all colour vanished except a slight effect due apparently to the metal itself

Some curious results were observed on strips of metal cleaned with fine emery paper The direction of the scratches was parallel to the length of the strip, and in the direction of increasing thickness of the oxide film. At angles of incidence varying from 70° to 80°, the change in the second order colours was marked in the direction of the scratches However, no change whatever (except increase in the generally reflected light) could be observed when the illumination was perpendicular to the lines of the scratches

In this case the strips were mounted on a spectrometer table and the telescope replaced by a microscope It then appeared that the colour of each filament remained unaltered, but that reflection occurred along a different line as the angle of incidence increased. Thus though the angle of incidence on the plane of the metal surface had varied widely, the angle of reflection from the coloured filaments in the surface had varied but slightly.

We wish to thank Abdel Hamid Effendi for the care he has taken in preparing the metal strips.

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Rationalisation of Scientific Publication

THE Publication Committee of the Society of Public Analysts and Other Analytical Chemists has discussed a reference (p. 358) in a leading article in NATURE of March 9 to the abstracts published by the Society in its journal, and I am instructed by the Committee to direct your attention to inaccuracies in the strictures contained in that article

It is not true, as the article states, that the abstracts in *The Analyst* are merely later duplications or variations of abstracts already published by the Bureau of Chemical Abstracts. On the contrary, they are made directly from the original papers, and are frequently published before the abstracts issued by the Bureau These points, however, are of minor significance as compared with the character of the abstracts themselves, which are constructed on completely different principles from those adopted by the Bureau In the first place, all abstracts in *The Analyst* are given with sufficient detail to enable an analyst to try the method in his laboratory without having first to refer to the original paper Secondly, every abstract is minutely scrutinised, first by a specialist in the subject, and then by the Publication Committee, and if the method is found to be unsound, or to be wanting in novelty, the abstract describing it is not published

The principle adopted by the Bureau of Chemical Abstracts is different from this Its object is to give the gist of the paper abstracted, leaving the reader to refer to the original paper if he wishes to obtain working details of any method Doubtless this method of presenting abstracts saves space, but it cannot be claimed that it gives detailed working accounts of methods or affords any guidance to an analyst

This Society is always willing to co-operate with other chemical societies, but attacks showing so little understanding of the objects and needs of a particular society will not tend to promote co-operation

C. AINSWORTH MITCHELL
(Secretary and Editor).

Society of Public Analysts
March 29

MR. MITCHELL's letter in itself fully substantiates the statements made in the article I do not think he is entitled to say that the article is in any way inaccurate The substance of the charge is that the abstracts provided by the Society of Public Analysts in no way break fresh ground, they merely duplicate the effort which is expended by the British Chemical Abstracts, for example Mr Mitchell's letter shows clearly that the failure of the Society of Public Analysts to co-operate with the Bureau is due, first to a radical misconception as to what an abstract should provide, and second to the narrow specialist outlook which so largely frustrates efforts at co-operation

With regard to the first point, it cannot be maintained that an abstract should provide the full working details required If, as Mr Mitchell appears to contend, an abstract is insufficient for the purpose of his Society, he is advocating essentially a policy of reprinting published information in whole or in part This is in itself a lamentable source of duplicated effort and expenditure in the profession of chemistry, due, as Mr. Mitchell's letter shows, to the specialist's insistence in putting sectional needs before the general interest.

The reference to the Society of Public Analysts, however, was only made by way of illustrating a point in the article, which covers a great deal of ground It would not have been in keeping with the spirit of the article to have elaborated the point, even had there been any wish to do so

THE WRITER OF THE ARTICLE.

Sense-Organs in *Malacobdella*

WHILE examining living specimens of *Malacobdella grossa*, Müll., under a binocular dissecting microscope (the specimen being extended under a glass slide in sea-water in the usual manner), I noticed a pair of minute structures on the head, which, so far as I can trace, do not correspond to anything previously described in this species. Fig. 1, drawn from a living specimen, shows these organs anterior to the cerebral ganglia, which send a small nerve in their direction They have the appearance of small pits on the dorsal surface, suggestive of sense-organs They are unpigmented.

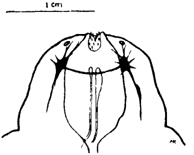

FIG 1 Head of *Malacobdella grossa*, drawn from life

I have examined serial sections of a specimen in which these 'organs' were seen during life, but so far have failed to find them, they have, however, been observed on several living specimens They are more conspicuous in large specimens If they are sense-organs, the fact is of some interest, since, except for the neuro-epithelial cells, *Malacobdella* has been supposed to be entirely devoid of these[1,2] A cephalic slit is present in most Nemerteans in a variety of forms, and a reduced cephalic slit might well present the appearance shown In some Nemerteans the cephalic slits are more superficial depressions; and if, as a result of the semi parasitic habit, these became reduced in *Malacobdella* to a vestige, they might be difficult to trace in preserved specimens, though visible during life.

The specimens were obtained in *Pholas* from the collecting ground known as 'Black Rocks', on the Anglesey shore at the eastern end of the Menai Straits. I can confirm the remarks of Gering[3] that the dimensions of *M. grossa* usually given are an understatement Living specimens measuring 45 mm. long in a state of moderate extension have been obtained here, whereas the largest Kiel specimen observed by Riepen was 22 mm. in length, and the largest Iceland specimen 30 mm. Blanchard[4] records a maximum length of 40 mm. The frequency here is also high, practically 100 per cent of specimens of *Pholas* being infected, as compared with less than 60 per cent infection recorded by Riepen for the host *Cyprina* at Kiel.

My thanks are due to Dr. Stiasny Wijnhoff for advice and assistance with the literature.

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University College,
Bangor.
March 14.

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[1] Riepen, *Z. Wiss. Zool.*, 143; 1933.
[2] Burger, "Fauna und Flora des Golfes von Neapel", No 22 1895.
[3] Gering, *Z. Wiss. Zool.*, 97; 1911.
[4] Blanchard, *Ann. Sci. Natur.* (Series 3), Paris, 1845

Discriminative Ability of a Parasitoid

IT has recently been demonstrated[1] that *Trichogramma evanescens* and certain other parasitoids are able to distinguish between healthy hosts and those already parasitised. Hearing cannot enter; sight and touch have been ruled out, and it appears that the sense used is that of smell

The discriminative ability is much finer than was supposed, as shown by the following experiment A *Trichogramma* female was allowed to walk upon and to examine a number of host eggs, but not to parasitise them The parasite was then removed and an equal number of clean hosts placed alternately among the others A second parasite now introduced avoided the hosts that had been visited by the first, as though they had already been parasitised The experiment has been performed several times, and there can be no doubt that *Trichogramma* females are able to distinguish clean hosts from those that have previously been merely walked upon by another female of their species, and that they avoid attacking the latter They seem also to be able to distinguish hosts on which they themselves have walked from those which have been visited by another individual.

One of us (J L) is now working on the application of this result to the spatial distribution of *Trichogramma*, and has evidence that the parasites are aware when they are moving over a surface previously walked upon by another parasite

This result renders intelligible a previous observation[1] on *Collyria calcitrator* and *Ibalia leucospoides*. Both of these parasitoids attack hosts which are buried in plant tissues and are therefore not available for examination Yet they tend to avoid superparasitism Possibly in these cases, too, the parasites are able to detect, on the surface of the wheat or of the wood, chemical traces indicating that another of their species has been there before them.

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[1] Salt, G, *Proc Roy Soc*, B, **114**, 455, 1934.

Apus cancriformis in Great Britain

Apus cancriformis has been so rarely recorded in Great Britain that it is of interest to report its occurrence in 1934. Some dried mud was collected from a pond in the New Forest district for the purpose of rearing *Chirocephalus diaphanus*, which was known to occur there. Distilled water was added to the mud on August 9, 1934, and larvæ were first noticed on August 12. These larvæ proved, on examination, to be those of *Apus cancriformis*, and not of the expected *Chirocephalus* Development proceeded, but many died. One individual measuring about 6 mm. across the carapace and 12 mm. from the anterior margin of the head to the base of the caudal furca was preserved on September 29 Another was exhibited alive at the Linnean Society's reception in October last.

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JOSEPH OMER-COOPER.

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March 22.

Chemistry of Œstrogenic Substances

WE wish to make the following comments on the communication by E Friedmann in NATURE of April 20 (p 622) under the above title :—

(1) Dr. Friedmann apparently believes that the œstrogenic activity of synthetic compounds was first observed by Blum Bergmann[1], and afterwards verified by Cook, Dodds and Hewett[2] with compounds of analogous structure The reverse is, of course, the actual sequence of events, as is shown by the reference to our original publication in the paper of O Blum-Bergmann, wrongly quoted by Dr Friedmann as O Blum and E Bergmann.

(2) If Dr Friedmann had read our detailed publication[3] as well as our preliminary communication[1], he would have realised that the generalisation which he now makes regarding the molecular conditions necessary for œstrogenic activity does not accord with the facts For example, our series of diols derived from 9 · 10–dihydro–1 2 5 6–dibenzanthracene contains inactive members as well as compounds having an extremely high order of œstrogenic activity Yet if Friedmann's generalisation were true they should all be active Moreover, we have reported the œstrogenic activity of certain hydrocarbons, which, of course, cannot conform to any rule concerning the relative positions of an aromatic ring and the carbonyl or hydroxyl group. In addition, we observed activity with ergosterol and calciferol, which contain no aromatic or analogous furane ring In any event, the large doses of 1-keto–1 . 2 · 3 4–tetrahydrophenanthrene necessary to produce œstrus (50–100 mgm in rats) preclude any far-reaching deductions from the inactivity of the isomeric 4–keto compound in similar doses If, for example, the 1–keto compound had given positive results with doses of 0·1 mgm., and the 4–keto compound negative results with 100 mgm., there would have been more adequate basis for generalisation

Our experiments (in collaboration with Mr W Lawson) on the biological effects of diols prepared by the action of Grignard reagents on various quinones continue to yield results of interest, which will be fully reported when they are complete

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E C DODDS

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[1] O Blum-Bergmann, *Naturwiss*, **21**, 578 1933
[2] Cook, Dodds and Hewett, NATURE, **131**, 56, 1933
[3] Cook, Dodds, Hewett and Lawson, *Proc Roy Soc*, B, **114**, 272 1934

Refractive Index of Heavy Hydrogen

IN the course of the recovery of some heavy water residues by electrolysis, the gas (D_2) was passed after purification through one side of the double tube (75 cm. in length) of a Rayleigh gas interferometer, while hydrogen gas produced by electrolysis of ordinary water and similarly treated was passed through the other side. A final steady shift of 24 drum divisions of the compensating plate was required to compensate for the difference of refractive index of the two gases This is equivalent to 1·68 fringes of the mercury line $\lambda = 5461$, and hence the difference of refractive index of ordinary and heavy hydrogen in the visible region is $(123 \pm 2) \times 10^{-8}$ at 760 mm, ordinary hydrogen being the greater The gas passed when the final reading was observed was burnt and collected separately, and proved to be within 0·1 of 100 per cent heavy hydrogen (D_2)

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March 26

Deuterium Content of Naturally Occurring Water

THE deuterium content of naturally occurring water has so far been determined by two methods—from the mass spectrogram of the hydrogen derived from it; and from the specific gravity of deuterium-free water The former method[1] gave for the abundance ratio H/D the value 5000 ± 500, while two discrepant values[2,3] have been obtained by the latter, namely 9000 and 5750 ± 250

In order to clear up this discrepancy, we have measured the specific gravity increase caused by electrolysing tap water (+2 per cent caustic soda) This method presupposes a knowledge of the separation coefficient α, and is only susceptible of accuracy if α is not too low and varies between fairly narrow limits Experiments using water of known deuterium content had shown that for iron cathodes, α (corrected for evaporation) has an unusually high value; in seven experiments α had the extreme values of 8·65 and 11·0

In three separate experiments, 240 c c of tap-water were reduced to 20 c c by electrolysis with iron cathodes and the increase in specific gravity measured Taking $\alpha = 11·0$, the values obtained for the ratio H/D were 6640, 6390 and 6230 respectively, while for $\alpha = 8·65$ the corresponding values were 6230, 5980 and 5840, giving for the most probable value H/D = 6220 ± 300.

This is in agreement with the value 5750 ± 250 obtained by Johnston His result and ours, taken together, suggest that the mass spectrographic value is slightly too low, and are irreconcilable with the value of 9000

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R P BELL
J H WOLFENDEN

Balliol College and
Trinity College Laboratory,
Oxford
March 30

[1] Bleakney and Gould, *Phys Rev* **44**, 265 1933
[2] Ingold, Ingold, Whitaker and Whytlaw Gray, NATURE **134** 661, 1934
[3] Johnston, *J Amer Chem Soc*, **57**, 484, 1935

Philosophical Interpretation of Science

I HESITATE to reply to Prof H Levy's letter in NATURE of April 20 because the questions raised are matter for arm-chairs and midnight oil rather than correspondence. Some comment, however, must be made, so, leaving the justification of my own philosophical outlook for a more convenient occasion, I will simply refer briefly to the charge that I am representing my viewpoint as "a necessary consequence of scientific discovery".

I can only say that I do consider it a necessary consequence of scientific discovery That, of course, does not prevent me from believing that others hold different opinions it simply leads me to think that they are mistaken. Frankly, I cannot conceive a better reason for holding an opinion than the belief that it is true It may be, however, that Prof Levy intended to charge me with trying to propagate my opinions among the uninitiated by disguising them as scientific facts. If so, I must say that the reader who could mistake the passage he quotes for anything but an attempt to interpret scientific procedure or who could regard any such interpretation as established truth, must be more uninitiated than one imagines readers of NATURE to be Surely one cannot be expected to encumber every sentence with "in my opinion" or "it seems to me" or "I think that", when it is obvious that the matter dealt with belongs to the world of opinion and not to that of fact But Prof Levy does seem a little confused about vital distinctions, for he refers to my interpretation as "itself surely an experience", and asks whether I am not compelled to refuse my philosophy any status in the external world Since he regards interpretation as experience, he has not begun to understand what I have been trying to say, and it certainly never occurred to me to claim that the external world contained philosophies

It may not be superfluous to add that since the review from which Prof Levy quotes was specifically concerned with the fact that one very eminent scientific man, whose insight I thought I acknowledged clearly enough, did not share my interpretation, an acute reader might have suspected that that interpretation was not indisputable On the other hand, out of a multitude of scientific men who could be quoted in support thereof, I select for want of space, only two, 'tolerably known in the revolution'. In "Atomic Theory and the Description of Nature" (p. 1), Bohr writes "The task of science is both to extend the range of our experience and to reduce it to order" In "The Meaning of Relativity" (p 1), Einstein writes "The object of all science, whether natural science or psychology, is to co ordinate our experiences and to bring them into a logical system" Neither writer explains that he is merely expressing an opinion, or indeed shows any awareness of the "very many men of science" whose views Prof Levy summarises

HERBERT DINGLE

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May 1

Points from Foregoing Letters

INJECTIONS of an extract of the posterior lobe of the pituitary gland produce notable changes in the blood of rabbits, leading to anæmia, according to Prof E. C Dodds and Mr R L Noble The red blood cells show abnormal inequality in size (anisocytosis), some being very large (macrocytes), others of irregular shape (poikilocytes) or having a network pattern (reticulocytes). The spleen shows wedge-shaped areas (infarcts) due to hæmorrhage From these changes the authors infer that the control of blood destruction may reside in the posterior lobe of the pituitary.

Chromosomes show great variation in size and shape Dr D M Wrinch discusses some of the factors that may give the constituent micelle of the chromosome the power to contract and change its shape Among these factors are the attraction between basic and acidic groups, the variation of the number of such groups within the molecule due to changes in the acidity-alkalinity of the medium (pH), the folding due to molecular linkage, as in keratin, etc

Mr D. Cameron discusses the best conditions under which tracks of α-particles can be observed in the presence of strong γ-rays during processes of disintegration, and shows how to determine the cross-sections for the disintegration of the beryllium nucleus by quanta of action

The liberation of electrons by light, a phenomenon of great importance in television, etc, shows in certain instances a strong narrow maximum as the wave-length of light is changed Prof Fowler has explained this selective effect as due to surface conditions, the original metal being covered with an electro-negative layer a few molecules thick and then again with a mono-molecular positive layer This view has been opposed by Zener, Mr. K. Mitchell now claims that Zener's objections are not valid, and that Fowler's theory can explain the observed facts both qualitatively and quantitatively He also shows that the theory leads to a peculiar form for the normal velocity distribution of electrons from a selective emitter, and appeals for experimental evidence on this point

Mr C. W Davis shows how, by means of high-frequency damped oscillations, materials of high coercive force can be demagnetised The method should be useful in the determination of magnetic properties of powders, the testing of iron and steel bars, in processes involving magnetic separation of ores, etc

The colour-changes of burnished surfaces of copper and steel seen at different angles are greater than expected from the refractive indices of their oxide films, according to Prof F H Constable and Messrs M Nazif and H. Eldin The authors also describe colour effects due to scratches on strips of these metals cleaned with fine emery paper

Dr L H Jackson submits a diagram and describes a pair of minute structures suggestive of sense organs on the head of *Malacobdella grossa*, a leach-like worm parasitic upon molluscs such as the chalk-boring piddock (*Pholas*)

The parasite insect *Trichogramma evanescens* shows greater ability than hitherto suspected in distinguishing between healthy egg-hosts and those already infected; Dr G Salt and Miss J Laing believe that the sense used in discrimination is that of smell

The synthesis of compounds having some of the properties of the natural sex hormone has lately attracted much attention Profs. J W. Cook and E. C Dodds dispute Dr Friedmann's views concerning the relation between œstrogenic activity and molecular structure as recently set forth in these columns.

Heavy water is rapidly becoming a commercial product and the proportion in which it is present in ordinary water is therefore important From the increase in specific gravity following upon an electrolysis of tap water, Messrs. A J. Edwards, R. P. Bell and J. H Wolfenden calculate this proportion to be one part in 6,000, as against one part in 9,000 previously deduced from mass-spectrographic data.

Research Items

The Ovingdean Skull. This remarkable trephined skull—a deformation, of which only two other examples of prehistoric date are known from Great Britain is described by Dr T Wilson Parry and Miss M L Tildesley in *Man* of April The skull was trawled from the sea about three quarters of a mile from the Sussex coast on January 12, 1935 It belonged to a man about sixty years of age, and its surface and texture denote that it had been interred It is not complete At the fore part of both parietals, an inch from the middle line on either side, are two well-defined perforations That on the right side is almost circular and measures $1\frac{13}{32}$ in by $1\frac{1}{4}$ in That on the left is roughly rhomboidal, the long diameter being $1\frac{1}{4}$ inches and the antero posterior $\frac{13}{16}$ in The method of trephining employed was that of scraping the bone with a flint flake so as to produce a funnel-shaped hole with sides sloping downwards and inwards towards the lumen, a method followed in the third, or Carnac, phase of the neolithic The operation was performed during life, as the bone shows a slight attempt at reparation A severe septic periostitis followed, which must have lasted about six weeks Miss Tildesley's examination indicates that there is nothing in the type of the skull to indicate its date Similar shapes occur among the Coldrum skulls, but also elsewhere Maximum breadth alone can be estimated The fragment is 143 mm broad and it is unlikely that the original maximum breadth was more than a millimetre or two more This lies half way between the greatest average found in the Beaker folk and the lowest found among the neolithic The bone is hard, suggesting mineralisation, and light grey in colour The circumstances suggest a cliff burial, which had fallen into the sea, but its colour and consistency are not the same as other bones from the chalk At the same time, it is not of an appearance which would suggest that it had come from a submerged neolithic forest bed The only clue to date is the trephining

Initiation in Southern Nigeria. An account of certain aspects of the *Otu* system of the Isa sub-tribes of the Edo people of Southern Nigeria by Mr. H L M Butcher (*Africa*, **8**, 2) indicates the importance of this organisation, which in some respects resembles an 'age grade', in others a caste system, in the social system of the people under the Oba of Benin As a democratic institution it developed most characteristically in remoter districts where the people were less subject to the power and influence of the Oba Development, however, was not uniform, and local isolation has produced a number of variants In some the importance of the passage from grade to grade is ignored Members of the lowest grades in all groups alike are called 'sweepers of the streets', and consist of all youths who are able to do any work They perform all communal tasks, such as hewing wood, drawing water, etc Next are the 'adults' who are in the prime of their strength, and mostly have homes and families They do such work as may be beyond the power of the youths The senior members only fight in the serious wars, the minor raids being left to the younger men. Though they have no right to speak in the council, their numbers lend weight to their ideas. Above them are the 'junior elders', heads of families, seniors in the small divisions of the villages, who in most cases have performed a ceremony to free themselves from communal labour, but are not yet members of the council Finally, there are the 'elders', the repositories of justice and custom, at whose head is the senior elder His is the final word in the council, and usually he serves the ancestral ju-ju In most groups he is the administrative, as well as the religious, head of the community With the Otu are associated two classes of ceremony, the first is a 'qualification' ceremony and the second the group of ceremonies by which promotion is gained within the Otu

Rats and Mice of the Pacific Islands. Of the five forms of rats and mice found by the Whitney South Sea Expedition in the Pacific Islands, four are ship-borne, and have a world wide distribution, the black rat, the Alexandrine rat, the brown or 'Norwegian' rat and the house mouse (G H H Tate, *Bull Amer Mus Nat Hist*, **68**, 145, 1935) These were probably introduced before the advent of white men, and the distinction between their arrival and that of the species regarded as the only true colonist of the Islands, *Rattus exulans*, is only a matter of degree, for the latter also owes most of its spread to mankind The native rats belong to the *concolor* group of Malaysia, but none of the island members of the group is identical with any living mainland species or with the forms found in Borneo, the Philippines, Celebes or New Guinea They tend to be larger than mainland forms, and on some of the islands show slight anatomical modifications Since all the rats and mice have been transported by man they must have followed his colonisation tracks, but this is not obvious from their present distribution since they show no diminution in number of forms from west to east Probably the original course of distribution from the mainland was by way of Borneo and the Philippines via the Caroline Islands, rather than through New Guinea and the Solomon Islands

Newfoundland Fisheries In the Reports of the Newfoundland Fishery Research Commission, vol 2, No 2 (Annual Report for 1933, recently published), good progress in all directions is shown Besides the technical research into the dried codfish industry and the nutritive value of the Atlantic salmon, the hydrographical and biological investigations are of special interest There are now available for comparison complete data for both spring and autumn seasons in 1932 and 1933 and partial data for the autumn of 1931 In the last report (vol 2, No 1) it was stated that, compared with the conditions in the autumn of 1931, there was in 1932 a much larger influx of arctic water into the Newfoundland area and simultaneously a stronger and opposite influx of salter water from the Atlantic occurring in the deeper water layers over the Banks These conditions led to the production of a large body of 'mixed' water suitable for the multiplication of marine forms of life, so that the season on the Banks and the coasts sharing 'Banks' conditions was a good one for the fishery, there being a marked increase in the plankton In the present report it is shown that this increase continued to a maximum point during the summer of 1933, but that in the autumn there was a sharp decline, apparently coinciding with a marked diminution in the general influx of arctic water. In 1933 no salps were taken, indicating that Atlantic water, comparatively unmixed with water from other sources, did not invade the area, this is in accordance with the absence of high salinity water The Copelata form a valuable guide to presence or absence of squid, the movements of which towards the coast of Newfoundland have in the two previous years followed the trend of *Oiko pleura dioica*, and the marked increase of the cold water *O vanhöffeni* may perhaps always (as in 1933) precede a failure of the squid fishery for bait

An Ancient Egg The expedition to Texas, sent out by the Harvard University Museum, has discovered the world's oldest egg (Science Service, Washington, D.C) It is the egg of a dinosaur which lived on the shores of a great inland sea during Permian times, and if the famous dinosaur eggs from the Desert of Gobi may be put at 100,000,000 years old, the age of this new discovery must be of the order of 225 millions of years The egg, three inches long and rusty in colour, is unhatched and little distorted by the process of fossilisation Although it cannot be definitely associated with any particular animal, it is believed to be the egg of a large lizard like reptile, *Ophiacodon*, measuring about six feet from snout to tip of tail, and part of a skeleton of this creature was found near the egg

Germination of Lime Seed A very full study of the factors involved in securing prompt and abundant germination of the seeds of the lime is reported upon by J Nelson Spaeth in Memoir 169 of the Cornell University Agricultural Experiment Station His conclusion is that the pericarp is not important in delaying germination, but must be removed in order to treat the seed coat Its removal is difficult because it is tough and leathery whilst the seed coat is hard and brittle Seeds may be extracted by partially digesting the pericarp with concentrated nitric acid Delay in germination is due to the impermeability of the seed coat , the water excluding property depends apparently upon the compactness of the cellulose in the outer part of the palisade tissue of the seed coat, and treatment with concentrated sulphuric acid for 10–30 minutes renders the seed coat permeable without injuring the embryo within In view of the factor causing impermeability, the important result follows that air-dry storage, which dries this impermeable cellulose layer, increases this impermeability, and as a result air dried seeds after several years storage will remain impermeable to water for some years when placed in stratification

A Fungus Disease of Liverworts The *Gardens' Bulletin* of the Straits Settlements of January 26 contains an account of a new species of fungus, *Nectria egens*, parasitic upon a liverwort, *Leptolejeunia corynephora* Mr E. J. H Corner is the author of the paper, and shows that the fungus is a superficial parasite the hyphæ of which ramify in the grooves between the convex cell-walls on the surface of the liverwort thallus. Food is absorbed through hyphopodia, and the host is not visibly inconvenienced by the parasite Several other species of *Nectria* are known to attack bryophytes. Characters of the new species are given by a Latin diagnosis, and Mr. Corner has compared it with another bryophilous species, *Neotiella crozalsiana*, a Discomycete fungus with very similar characters except for a "persistently juvenile form of cleistocarpic operculate apothecium". *Nectria egens* is, of course, a definite Pyrenomycete, and the paper raises interesting questions as to fundamental differences between Discomycetes and Pyrenomycetes, other than the form of the fruit body

Brown Rot Diseases of Fruit Trees. Bulletin No 88 of the Ministry of Agriculture and Fisheries is devoted to "The Brown Rot Diseases of Fruit Trees" (London : H M Stationery Office, 1935 1*s*. 6*d*. net) It is, perhaps, rather significant that this imposing monograph, which is the work of Dr H Wormald, replaces a short leaflet of three or four pages The Ministry has performed a useful service to the fruit-growing community in thus collecting Dr Wormald's research papers and utilising his special knowledge to review the extensive literature on the subject This has been accomplished without prejudice to the needs of the practical grower, for descriptions of symptoms and advice on control can easily be separated from the more technical part of the volume The history of the appearance of brown rot fungi is traced since the first mention of *Monilia fructigena* by Persoon in 1796 It is only of recent years, however, that other fungi have been recognised as causal agents of brown rots *Sclerotinia* (= *Monilia*) *fructigena*, *S laxa*, *S laxa* forma *mali*, and *S fructicola* are described in the work under review, and cultural characters are also given A valuable feature of the bulletin is its international nature, which allows a survey of geographical distribution of the fungi to be made, and also outlines their probable effects on commerce Conditions conducive to infection, and the mode of entry into the host plant are adequately treated, whilst symptoms and control of brown rots on apple, pear, cherry, peach, nectarine, apricot, quince and medlar are described. Twenty-four pages of excellent half-tone illustrations enrich the text, and six pages of bibliography should be very useful to the plant pathologist

Chymase and Protease in Micro-organisms A year or two ago, Prof Constantino Gorini showed that the ability of bacteria to coagulate milk may be revealed by pouring milk which has been lightly sterilised on to the surface of a culture of the organism on agar containing such stimulants as broth, peptone, vitamins, yeast water, blood, etc In a paper read before the Reale Istituto Lombardo di Scienze e Lettere in November last and published in the *Rendiconti*, **67**, parts 16–18, Gorini describes the results of the application of this method of examination to a number of bacteria of various types Among these were 115 strains of *Streptococcus*, of different origins and belonging to 16 different pathogenic species. When inoculated directly into milk, these showed negative or irregular results On the basis of the chymase and protease indications of the milk-on-agar cultures, it was found that the organisms were divided between the three types, *Streptococcus pyogenes*, *S agalactiae* and *S. lactis*. The procedure is hence of diagnostic value in distinguishing between chronic mastitis specific to lactifers and harmless to man, and the acute mastitis the infecting agent of which is transmissible to man through the milk A number (18) of strains of *B typhi flavum* of various origins and eight physiological variants of *B. typhi*, Eberth, all displayed, however, similar behaviour, no differentiating criteria being observable. Extension of the method is suggested as a possible means of distinguishing between bacterial species.

Apparent Magnitude in Scenery. Scenery, being a pictorial impression of the outdoor world, does not lend itself to direct measurement, which impairs the spontaneous effect on which the impression depends. In a paper on "Apparent Magnitude in Natural Scenery" in the *Geographical Journal* of March, Dr Vaughan Cornish attempts to discover some principles applicable to the study, using as his material outline drawings of landscape which he has been in the habit of making, without any direct measurement, during the past forty years. Thus, for example, he compares two alpine panoramas each including the rising sun, drawn at distances of four and forty miles respectively. In the latter case the sun's area was increased 3.16 times the former. The customary explanation is the mental comparison of magnitude between the unvarying sun and the varying angle of the landscape, and in other words that the mountains diminished in size as their distances increased and that the increase in the apparent size of the sun was inversely proportional to the change in the apparent magnitude of the mountains. But an examination of the drawings, of which the view-point was known, showed that the diminution in the apparent magnitude of the mountains was much less than the increase of their distance, and simple measurements revealed the fact that the distant mountains were subjectively magnified to the same extent as the sun. Another among many suggestions in the paper is that the more the eye takes in vertically the more it takes in horizontally and the less impressive are both dimensions.

Radioactivity of Potassium and Rubidium. Klemperer (*Proc Roy Soc*, A, March 15) has investigated some anomalous and interesting features of the β decay of potassium and rubidium. According to Fermi's theory and Sargent's empirical rules, the decay period of a β transformation is connected with the upper energy limit of the β-spectrum, and if these rules are applied to potassium, they give a period of a few minutes or a few days, according to whether the β-transition is of the 'allowed' or 'forbidden' type. The measured half decay period is of the order $7 \cdot 5 \times 10^{11}$ years on the assumption that the heavy isotope, $_{19}K^{41}$, is alone active, and it is therefore necessary to examine alternatives to the simple reaction,

$$_{19}K^{41} \rightarrow {_{20}Ca^{41}} + \beta$$

It must be noted that $_{20}Ca^{41}$ has never been found by mass-spectrum analysis of old potassium minerals. Gamow has suggested as alternative schemes, (1) the simultaneous emission of two β-rays, (2) an α-decay, followed by the observed β-decay which comes from a short-lived halogen atom, and (3) a slow β-decay followed by the observed β-rays which come from short-lived calcium and strontium atoms. Klemperer has examined the first coincidence Geiger counters, and the second and third by chemical separations and the use of a linear amplifier. The results were negative in each case. He suggests that the β-rays come from undetected, rare, but still long-lived isotopes, $_{19}K^{40}$ and $_{37}Rb^{88}$. The anomalous lifetime of these elements (with respect to the Sargent rules) would be explained if they had a large nuclear spin, the β-ray being then a kind of 'super-forbidden' transition. Newman and Walker (*Phil Mag*, April) also suggest that the radioactivity of potassium may arise from $_{19}K^{40}$ or $_{19}K^{41}$ and that of rubidium from $_{37}Rb^{86}$, $_{37}Rb^{87}$ or $_{37}Rb^{88}$. Their suggestion that these isotopes could be produced experimentally by neutron bombardment is probably not practicable.

Discovery of Mephitic Air. In 1772, Daniel Rutherford (1749–1819), professor of botany in the University of Edinburgh, published his "Dissertatio Inauguralis de Aere Fixo Dicto aut Mephitico", in which he announced among other matters his discovery of 'noxious air', afterwards called nitrogen. In *Science Progress* (**29**, 650, 1935), D McKie has made an interesting analysis of the part of the dissertation concerned with nitrogen and shows that, contrary to the usual statement, Rutherford did not use the name 'mephitic air' for this gas, but for the 'fixed air' (carbon dioxide) discovered by Black, referring to nitrogen as another species of noxious air. He found that when an animal was confined in a limited volume of air it presently expired and the air was reduced in volume and rendered incapable of supporting fire or life. Removal of 'fixed air' by alkali did not restore it to its former wholesomeness. The relations to Priestley's discoveries are considered, and it is concluded that Rutherford's work was quite independent. Rutherford did not arrive at any clear explanation of his results, and did not see that the 'noxious air' (nitrogen) was a constituent of the atmosphere, regarding it rather as air combined with phlogiston.

A New Relativity Theory. A second instalment of Sir Shah Sulaiman's new theory of relativity has appeared (*Proc Acad Sci U P India*, **4**, 217), the first part appeared in the same journal (**4**, 1) in August 1934. The author retains Euclidean space, and as much as possible of Newtonian dynamics, the chief deviation being the hypothesis that gravitational, electrical, and magnetic forces do not act instantaneously, but are propagated with a velocity nearly equal to that of light. Light is supposed to consist of 'radions' emitted from the surface of bodies, and gravitation of 'gravitons' from their entire mass. From these hypotheses four 'universal principles' are deduced. Two of these, akin to Doppler's principle and aberration, deal with the modification of the magnitude and direction of the gravitational force upon a moving body, and these are applied to the advance of the perihelion of Mercury, the deflection of light by gravitation, the spectral shift, and the experiments of Michelson and Morley, and of Bucherer. Another gives a formula for the relative velocity of two moving bodies, which is applied to the experiments of Fresnel and of Fizeau. The remaining one is applied (in outline only) to the fine structure of the hydrogen spectrum. The idea of an expanding universe is firmly rejected, though it is allowed that some nebulæ, formerly part of our galactic system, have left it on parabolic paths. In short, an attempt is made to give an alternative explanation for the whole range of phenomena usually adduced in support of Einstein's theory. It is difficult to form a definite opinion whether the author's work is entirely sound, but he has evidently studied all the standard works. The mathematics has been checked by two competent mathematical physicists, and the work has been carried out with the encouragement of Prof M N Saha. If it can stand the test of criticism, it will obviously be of great importance.

Social and Economic Conditions of West Australian Aborigines

THE report of a Commission of Inquiry on social and economic conditions among the aborigines of West Australia and the working of the State system of protection, which was published on March 12 last, criticises strongly the inadequacy of the provision for medical attention, the inefficiency of the care for half castes and the wasteful and unsatisfactory character of the management of the Moore River settlement. The Commissioner, Mr. H. D. Moseley, is doubtful of the success of the missions among the aborigines, and he finds that allegations of cruelty and ill treatment of the aborigines, which have appeared in the public Press from 1930 onward, are without foundation.

In the north and north west, natives on pastoral properties, the Commissioner reports, experience conditions which as nearly as possible approach their natural life. The work of the aborigines employed on stations takes an appropriate form, and the only criticism of the Government stations is that a greater effort should be made to keep the aborigines more constantly employed. The 'bush' natives are best left alone, and the land now occupied by them should be secured inalienably as a reserve and additional land should be set aside for reserve purposes in anticipation of closer white settlement in the northern area. The native is under no hardship through the non payment of wages, and there is nothing approaching a condition of slavery. In the north-west, where the wage system has been in operation for some time, it has encouraged the gambling and squandering habits of the aboriginal.

To meet the inadequacy of the present medical attention available, the establishment of clinics and hospitals is recommended at four points to facilitate early diagnosis and treatment. Farther south, in the areas of closer settlement, increased hospital accommodation is recommended, the existing accommodation being both inadequate and undesirable in character. In addition to providing first-aid stores, employers of labour should be required to make payment into a medical fund on account of each employee, and in this connexion the present system of licenses for labour is criticised, as it does not require particulars of individual employees to be reported, but merely the total number employed. A system of registration is therefore recommended.

In dealing with leprosy, the inadequacy of the provision for segregation of detected cases awaiting transhipment to the leper hospital at Darwin, and the delay in evacuation are strongly criticised. It is suggested that the State should withdraw from the arrangement whereby leprosy is made a Federal concern and provide a leprosarium of its own on one of the islands off the coast; but if this is impossible, that suitable arrangements should be made for isolating detected cases, while the inspection for leprosy and venereal disease, for which agitation has been going on since 1924, should be held forthwith.

If conditions in the sparsely settled north and north-west can be regarded as satisfactory on the whole, except as regards the medical question, it is far otherwise in the more closely settled south, where the aboriginal has come more closely into contact with white civilisation, and native camps are situated in close proximity to the towns. In the Moore River settlement, children and young persons are being educated and trained in close proximity to the camps for indigent aborigines, without proper measures being taken to keep them apart; hence most undesirable results, especially as affecting young girls. The buildings are inadequate, verminous and inefficient, and proper educational equipment is lacking. The care of half castes is thoroughly inefficient and inoperative. So far as possible, camps should not be allowed to remain near the towns. It is recommended for both able-bodied aborigines and half-castes that a system of farm-stations should be established on which adults and parents could work on their own allotments, while the children were trained for suitable occupations. An extension of the existing arrangements for the training of girls for service and other occupations is also recommended.

In regard to the laws affecting aborigines, the most important measure suggested is the provision of special courts for the trial of 'bush' natives, in which the proceedings would be suited to the code of the native and such as he himself and the members of his tribe would understand. The holding of such courts might be part of the duties of a district protector on patrol.

It is pointed out how far the criticism of existing conditions is concerned with matters which can be attributed to the defects of the present organisation of protection, whereby the Chief Protector, assisted by more than a hundred honorary protectors, who do not function except to grant permits to employ labour, has been overburdened with office work and has been unable to travel and inspect actual conditions. A reorganisation is recommended in which the office of Chief Protector should be abolished, and his place taken by a secretary of the Department, who would be responsible for office detail, while the active work of protection would be in the hands of district protectors, of whom one, a medical man, should be appointed to the northern area forthwith.

The Collection of Dew

By H. E. Beckett and A. F. Dufton

ARISING from the serious shortage of water in many districts during the summers of 1933 and 1934, the suggestion was made that the collection of dew would be profitable and that research should be undertaken into the economic design of dew-ponds. A little consideration showed that certain types of roofs, suitably insulated underneath, might act as economical and efficient collectors of dew.

If 'dew ponds' really do collect dew owing to the cooling either of the water surface or of the surrounding banks below the dew point, by radiation to the night sky, even more dew should be collected on a thin metal roof of low thermal capacity, provided that the roof has an efficient radiating surface and is prevented from gaining heat from below.

In order to find whether sufficiently low temperatures could be obtained on thin metal sheets and to what extent these temperatures were affected by surface treatments of the sheets and by the amount of insulation beneath them, four galvanised iron sheets, measuring 4 ft. 3 in. square, were supported off the ground and exposed out of doors at the Building Research Station. One sheet was left plain, another was formed into a shallow tank and filled to a depth of 1 in. with water, the two remaining sheets were whitewashed on the upper surface and one was provided with 7 in of cork insulation underneath

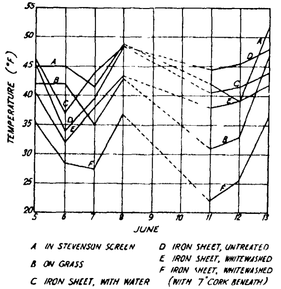

FIG 1 Minimum temperatures

Each sheet was provided with a thermocouple by means of which its temperature was recorded The minimum temperatures recorded on a number of nights in June are shown in Fig 1 It will be seen that the specimen which was whitewashed on top, to reflect the sun's heat by day and to radiate heat by night, and was heavily insulated beneath with cork, became appreciably colder than any of the other specimens, the lowest temperature recorded being 22° F, 20° F below the screen minimum for the night

The next step was to experiment on a larger scale with an actual roof, to find how much dew could be collected For this purpose a section of a corrugated iron roof, 18 ft 7 in long by 11 ft wide and having a pitch of 7½°, was provided with separate drainage. The roof was insulated underneath with two sheets of aluminium faced asbestos paper, spaced 1 in apart, the equivalent of about 1 in of cork, and was whitewashed on top The temperature of the iron sheets was recorded by means of a thermocouple

Measurements were made on this roof on suitable clear nights from July to September, but the results were disappointing Dew *could* be collected on nights most favourable for the loss of heat by radiation, but suitable nights were by no means frequent, and, even then, the amount of dew collected was small A typical record is given below

Dew Collection on Night of Sept 21–22

Minimum roof temperature	28° F
Minimum screen temperature	36½° F
Grass minimum	29° F
Minimum temperature on bituminous felt on adjacent flat roof with 7 in of slag-wool insulation underneath	25½° F
Dew collected	70 cu in

The quart of water which is obtained on a night when the sky is propitious is a mere dribble compared with the 10 gallons which the same roof collects during 1/10 inch of rainfall, and it is obvious that, as an auxiliary water supply during drought, the collection of dew in this way cannot be seriously considered Storage for rain water is more economical to instal, more reliable and altogether more practicable

From the experiments described above, it may also be inferred that the action of 'dew ponds' cannot be ascribed to the ordinary deposition of dew This corroborates the findings of E A Martin[1], who as a result of an extensive study, decided that the ponds depend for their replenishment upon mists rather than dew and that the term 'dew pond' is a misnomer According to Martin, the word 'dew pond' does not appear to have been used prior to 1813 ("The Shorter Oxford English Dictionary" gives the date 1877) and, since then, although some ponds have borne that name others have been known as 'cloud ponds', 'mist ponds' or 'fog-ponds'

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[1] E A Martin, 'Dew-Ponds' T Werner Laurie, Ltd, London, 1911

Sylvicultural Research in Nigeria

SINCE the appointment of two sylviculturists for research in Nigeria in 1928, a remarkable amount of good work has been undertaken in connexion with the rain and moist deciduous forests in the south-western provinces In the *Oxford Forestry Memoirs*, No. 18 (Oxford, The Clarendon Press, 1934), Mr W D. MacGregor, one of the sylviculturists, publishes an account of his work in a brochure entitled "Sylviculture of the Mixed Deciduous Forests of Nigeria, with Special Reference to the South-Western Provinces".

The mixed deciduous forest type in West Africa is an important concomitant of the forest flora, coming between the true deciduous and the true evergreen forest types. Botanically it includes high forest trees of both types, but differs from the deciduous forest in containing evergreen under canopies, and from the evergreen or rain forest in containing top canopies of deciduous trees

From the forester's point of view, the mixed deciduous forest type is nearer to the deciduous than to the rain forest type It is in reality a climatic formation in which deciduous trees attain their optimum development In its most humid form, the mixed deciduous merges imperceptibly into the rain forest type It requires a rainfall averaging 50–70 inches per annum

Of the numerous natural orders of this forest type, *Sterculiaceae*, *Leguminosae*, *Moraceae* and *Combretaceae* are the most important The two magnificent trees *Triplochiton scleroxylon* and *Chlorophora excelsa* have the greatest range in distribution

With the evergreen forests to the south and the deciduous forests to the north, the mixed deciduous forests form an almost continuous belt of varying width running parallel to the coast. They are said to hold great timber wealth of large dimensions. They have not been exploited, however, to anything like the extent of the rain forests owing to their geographical position, which places them outside the zone of streams and rivers suitable for floating timber.

The object of Mr. MacGregor's memoir is to record all the experimental and research work in connexion with the sylviculture of the mixed deciduous forest type upon which he has been specially engaged, or on which other officers have obtained some experience of, for example, plantation work. In the latter work, fuel plantations have formed an important branch. Large areas of indigenous species have been planted at Akilla, Ondo Circle. At Mamu and Olokemeji teak has been successfully grown—but almost, until recently, at the expense of good local indigenous species. Latterly, however, research work in the nursery and plantation has been devoted to the study of the requirements of indigenous species with the view of replacing exotic species when possible.

It is a curious anomaly that here in the West African tropical forests, with a plethora of magnificent timber trees of which almost the only one known, during the past century at least, was mahogany, the first commencements of forest plantation work on a scientific basis should have been made with teak in several colonies to the neglect of some of the, admittedly little-known, indigenous species. The research work with the latter undertaken by Mr. MacGregor and ably depicted in this memoir proves that West Africa has timbers which will probably, in the future, be able to hold their own on any timber market in the world.

In addition to the nursery and experimental plantation work undertaken with indigenous species, sylvicultural experimental work in connexion with both artificial and natural regeneration has been commenced with considerable success.

Chapters are devoted to the description of the sylvicultural characters of a number of species, indigenous and exotic, and some excellent descriptions of seedlings. Finally, there is a report on the soils at Olokemeji by Mr. H. C. Doyne, senior agricultural chemist, and Mr. W. A. Watson, agricultural chemist, Ibadan.

Although perhaps it is too early to accept the mass of detail recorded in this important memoir as actually proved, without further check, yet Nigeria may be complimented on the methods upon which the work has been carried out.

The Broadcasting Wave-Lengths of Europe

THE plan for allocating the wave lengths of the broadcasting stations in Europe published in 1934, and known as the Lucerne plan, is getting more and more difficult to work. The trouble arises mainly from the fact that the full range of frequencies available for the carrier waves is 1,350 kilocycles per second, and in order to prevent serious overlapping, each station requires a width of about 10 kilocycles per sec. In order to secure agreement between the various nations concerned, it was necessary to allocate 133 channels to 170 working stations, so that some had to work at the same frequency, care being taken to give these frequencies to small stations at a great distance from one another.

Unfortunately, little attention had been given to limiting the power of large broadcasting stations, and so there are now thirteen in Europe which work at 100 kilowatts or above, eighteen with powers not less than 50 kw. and twenty with powers not less than 20 kw. Many of these stations are transmitting through the same zone of darkness, and it follows that the spectra of the waves radiated by powerful stations in contiguous channels will overlap. The overlapping sidebands of these unwanted stations produce serious interference.

In a paper on broadcast transmission read to the Institution of Electrical Engineers on May 1 by Mr. P. P. Eckersley, it is pointed out that at the present time the designer of a receiver capable of reproducing distant as well as local programmes is forced to cut off the upper audio frequencies of modulation, and this deleteriously affects the quality of the reproduction. The ordinary commercial receiver sold to-day to the public cuts off the audio frequencies above 3,500 cycles per second.

The only way to get over this difficulty is to change radio technique. It is improbable that European nations will agree to limit either the existing power or the number of their working stations. But if it were possible to modify transmitters so that the spectra of the waves radiated contained the carrier wave and only one set of sidebands, spectrum overlap could be minimised and in some cases entirely eliminated. If a frequency band of 2,000 cycles per second could be added to the ordinary breadth, a great improvement would result. The introduction of high-fidelity broadcasting would undoubtedly stimulate the industry of radio broadcasting.

Mr. Eckersley has recently been to the United States and has inspected the apparatus developed by Wired Radio Inc. for use in connexion with their high-frequency broadcasting system. He found that several of the methods he recommended were similar to their methods, and that a very high quality of reproduction was achieved.

University and Educational Intelligence

CAMBRIDGE.—The sixth course of Scott Lectures will be given by Prof. G. Hevesy in the Cavendish Laboratory at 4.30 p.m. on May 13, 15 and 17. The subject of the course will be "The Terrestrial and Cosmic Abundance of the Elements".

An election to the Isaac Newton Studentship will be held in the Michaelmas Term 1935. These studentships are for the furtherance of advanced study and research in astronomy and physical optics and are open to those members of the University who have obtained a degree in the University and were less than twenty-five years of age on January 1, 1935. Candidates are invited to send in their applications to the Vice-Chancellor between October 8 and 14, 1935. The emolument of the student will be £250 per annum.

EDINBURGH.—Mrs. Stewart Hall has given £15,000 for the endowment of a lectureship in the pathology of the diseases of children.

On the recommendation of the Joint Committee of the University Court and the managers of the Royal Infirmary, Dr. A. E. Barclay, lecturer in medical radiology, University of Cambridge, has been appointed lecturer in radiology in the University, on his appointment as radiologist to the Royal Infirmary from May 1, 1935.

THE International Federation of University Women held a meeting at Budapest in September last, when twenty-six national federations were represented. Among the resolutions adopted was one deprecating the "tendency, increasingly evident in the majority of countries, by new regulations to debar women from careers for which they are well qualified, whether on grounds of sex or marriage" and declaring such regulations to be "inimical to the family which is itself the foundation of society". Another deplores the contravention in certain countries of the principles that teaching history, etc, in schools should be impartial and that art, literature and science are a common human heritage and not the appanage of particular nations or races. The German Federation has passed through a difficult period, and it is hoped to reconstruct it on a basis which will eliminate discrimination on any racial, political or religious grounds The Austrian Federation was concerned about the bad effect of recent legislation on the position of women The Indian Federation reported a surprisingly large number of members -400 The British Federation gave scholarships last year enabling three German scholars and scientific workers who had lost their positions on account of their non-Aryan nationality or political opinions to live at Crosby Hall, London The next conference of the International Federation is to be held in 1936 in Poland.

"FREEDOM or Indoctrination an Enduring Dilemma of Education" a paper by Prof Marvin L. Darsie of the University of California, contributed to *School and Society* of February 2, deals judiciously with this theme—one that is in the forefront of current educational topics of discussion in the United States The recent development in Germany of authoritarianism in educational as in other fields has proved a powerful irritant provoking such discussion. Prof. Darsie's paper attempts an analysis of some of the complex factors associated with capitalism, scientific technology and the increasing solidarity of organised labour, in which the age-long conflict between the advocates of free intellectual inquiry and the guardians of established doctrine is to-day entangled Starting from the position that the concepts of freedom and indoctrination have to do with the interweaving of the "two innately conditioned desires for self-expression or pre-eminence and security within the immensely complex maze of social patterns constituting a culture or civilization" he proceeds to consider the resulting problems confronting the educator. The public school teacher functions in an agency maintained by society for the direct purpose of indoctrinating the young with the established institutional patterns. but these represent nuclei of public opinion substantial at the core but with continuously fluctuating margins. It is peculiarly the function of the enlightened teacher "to keep alive this fringe of experimental thinking and at the same time to prevent its detachment from the institutional matrices which guard the stability of any organized society". In this delicate task he must beware of endorsing or promoting any propagandist movement, but his obligation to human welfare requires him to defend and preserve the fringe of free experimental inquiry. The dilemma is discussed in terms of national policies in a short article, "The Great Rift in Education", by Dr. J. F. Abel in *School Life* of December.

Science News a Century Ago

Loads Carried by South American Miners

On April 27, 1835, Darwin set out from Valparaiso on horseback for Coquimbo, which he reached on May 14. On May 12 he stayed at some mines, and writing of the loads carried by the miners, he said . "Captain Head has described the wonderful load which the 'Apires', truly beasts of burden, carry up from the deepest mines I confess I thought the account exaggerated , so that I was glad to take an opportunity of weighing one of the loads, which I picked out by hazard It required considerable exertion on my part, when standing directly over it, to lift it from the ground The load was considered under weight when found to be 197 pounds The apire had carried this up eighty perpendicular yards, —part of the way by a steep passage, but the greater part up notched poles, placed in a zigzag line up the shaft According to the general regulation, the apire is not allowed to halt for breath except the mine is six hundred feet deep These men, excepting from accidents, are healthy and appear cheerful Their bodies are not very musculous They rarely eat meat once a week, and never oftener, and then only the hard dry charqui Although with a knowledge that the labour was voluntary, it was nevertheless quite revolting to see the state in which they reached the mouth of the mine , their bodies bent forward, leaning with their arms on the steps, their legs bowed, their muscles quivering, the perspiration streaming from their faces over their breasts, their nostrils distended, the corners of their mouth forcibly drawn back, and the expulsion of their breath most laborious After staggering to the pile of ore, they emptied the 'carpacho', in two or three seconds recovering their breath, they wiped the sweat from their brows and apparently quite fresh descended the mine again at a quick pace ."

Bird Distribution

Much new light on the distribution of bird life outside Europe was shed at the meeting of the Zoological Society of London on May 12, 1835, with Mr N A Vigors in the chair The skin of a kiwi, *Apteryx Australis*, Shaw, sent by the Colonial Secretary for New South Wales, was exhibited, along with an account of the habits of the bird, its probing of the ground with its long bill for earthworms and its scant distribution in New Zealand, whence it had been obtained by a correspondent who had seen only two during his stay there Colonel Sykes exhibited a series of bird skins presented to the Society from the Cape region of South Africa by Capt Spiller, and these, stated Sykes, had enabled him to make a comparison with the collection of birds he had shot in India, and those of Europe, to draw up a list of fifteen species of bird found equally in South Africa and India, four species found in South Africa, India and Europe, and two species 'universal', providing *Strix Javanica*, Horsf. was identical with *Strix flammea*, Linn. A female hybrid pheasant, *Phasianus colchicus*, produced by a cock pheasant and greyhen (*Tetrao tetrix*) from the Merrington Covers of Mr R. A Slaney, near Shrewsbury, was exhibited and described by Thomas C. Eyton

Geology of Seeland and Möen

At a meeting of the Geological Society on May 13, 1835, Lyell read a paper entitled "On the Cretaceous and Tertiary Strata of the Danish Islands of Seeland and Möen" According to a report in the *Philosophical Magazine*, "Mr Lyell examined, in company with Dr Forchhammer, the cliffs of Seeland and Möen during the summer of 1834, and the following are the results at which he arrived The two formations of which Denmark and Danish Holstein chiefly consist are chalk, and an overlying tertiary deposit Part of the latter resembles in composition the argillaceous and sandy beds of the English crag Another part corresponds with deposits usually called diluval, especially those associated with the English crag, in parts of Norfolk Large erratic blocks are also strewn over the surface of Denmark, connected with, and sometimes buried in the gravel, or 'diluvium' In some sections on the banks of the Elbe, the yellow tertiary sands are divided regularly into thin strata and are exposed for a thickness of about 200 feet The white chalk of Denmark is characterised by the same fossils as those of the upper chalk of France and England"

Water from the Well of Zem-zem

At a meeting of the Royal Society on May 14, 1835, a communication from John Davidson was read giving "*An Account of the Water of the Well Zem-zem*, with a quantitative analysis of the same by Professor Faraday" Davidson had sent home about three quarts of the water from the well of Zem-zem near Jedda, to which the Mohomedans ascribed a sacred character and extraordinary virtues The can containing the water had been sealed, but unfortunately it had been opened in the London Docks and the gas with which it was charged had escaped The precipitate thrown down was found by Faraday "to consist of carbonate of protoxide of iron in the enormous proportion of 100 8 grains to the imperial pint of water The clear liquid was neutral and contained much muriate, and a little sulphate but no carbonate, together with a little lime, potash and soda There was also found an alkaline nitrate in considerable quantities, this Mr Faraday conjectures to have been saltpetre, which had been added to the water by the priests"

Societies and Academies

PARIS

Academy of Sciences, March 25 (*C R*, **200**, 1077–1160) ROBERT LESPIEAU and PAUL HEITZMANN: The C_8H_{14} hydrocarbons arising from the action of crotyl bromide upon its magnesium derivative Three isomers have been isolated from the product of this reaction: their probable constitution is indicated GASTON FAYET was elected a member of the Section of Astronomy in succession to the late Benjamin Baillaud. JEAN LERAY. The topology of the abstract spaces of M. Banach. JEAN DELSARTE: The application of a general principle of development of the functions of a variable to the series of Bessel's functions. K. NIKOLSKY: The electromagnetic field of Dirac's electron EDGAR PIERRE TAWIL: Considerations on the development of electricity by quartz. The electricity developed by the torsion of quartz is named strephoelectricity, and reasons are given for regarding this as distinct from piezoelectricity. ALBERT MILHOUD: The electromotive force produced by the outflow of steam. Study of the effects on the electromotive force of the presence of traces of electrolytes in the drops of water in the steam jet J. CAYREL: Remarks on the energetics of thin plates placed in the midst of a polarisable medium. ROBERT BOSSUET The quantitative spectrographic analysis of the alkali metals. Application to cæsium in mineral waters The salts are volatilised in an oxyacetylene flame and the dilution determined at which the line 4555 3 vanishes Figures are given for the cæsium found by this method in ten French mineral springs JEAN TERRIEN: The absorption and fluorescence of the vapours of the cuprous halides. CHARLES LAPICQUE The distribution of light in the retinal image of a distant point MARC ANTOINE FOËX. The application of electrical conductivity to the study of separations in fused glasses CHARLES DUFRAISSE and MARIUS BADOCHE: Relations between the optical properties of the medium and the photochemical constants of tetraphenylrubene Individual influence of the chemical nature of various solvents The chemical nature of the solvent exerted a marked influence on the oxidation velocity MLLE PAULETTE BERTHIER The rôle of evaporation in the phenomenon of imbibition presented by porous bodies PIERRE DUBOIS The decomposition of permanganic acid and of manganese peroxide Details of the precautions necessary during the preparation of the peroxide to obtain pure MnO_2 ANDRÉ MORETTE A new method for the preparation of pure vanadium Metallic vanadium containing more than 99 per cent of the metal can be prepared by the action of magnesium on vanadium tetrachloride or dichloride at 700°–800° C Y. RENÉ NAVES, GEORGES BRUS and JEAN ALLARD Contribution to the study of the citronellol-rhodinol isomerism by means of Raman spectrography Comparison of alcohols obtained from various sources and carefully purified. DANIEL GARDNER, MICHEL PROCOFIEF, GEORGES JUSOV and MARIA LUCIANA CASELLI The synthesis of carvacrol Description of a complete synthesis of carvacrol, starting with paracymene A second method is from orthocresol and isopropyl alcohol, by treatment with phosphorus pentoxide MME NELICIA MAYER The composition of solutions of glucides after treatment with alkali RAYMOND PAUL: Oxidation and reduction phenomena observed in the catalytic dehydration of the furylalkylcarbinols PAUL GAUBERT: Modification of the facies of crystals of phloroglucinol by colouring matters, and the action of heat on the coloration. G CHOUBERT: The enclosures of some lodes in the neighbourhood of Bresse (Vosges) MME. ODETTE THELLIER Simultaneous measurements of various elements of atmospheric electricity. V GRÉGOIRE. New data on the morphogenesis of the leaf axis in the Dicotyledons FERNAND OBATON: The biological behaviour of *Sterigmatocystis Phœnicis* compared with that of *Sterigmatocystis nigra*. PAUL RIOU and JOACHIM DELORME: The presence of manganese in maple sugar and in cane sugar. MLLE E. LE BRETON, MAURICE NICLOUX and GEORGES SCHAEFFER: The coefficient of ethyloxidation and basic metabolism in some homeotherm species NICOLAS T. KORESSIOS, HENRI TILLÉ and JEAN CHASSANG: Comparative studies on certain physiological effects of cobra poison, filtered and unfiltered. The best conditions for experimenting with venoms. MARCEL GESLIN: Contribution to the study of the argon-nitrogen ratio in natural gases. Gases arising from the natural destruction of animal or vegetable organisms show a ratio of argon to nitrogen lower than that found in air. This is attributed to the nitrogen evolved from the animal or vegetable matter J ANDRÉ THOMAS The vitellin entoblast behaves *in vitro* as a merocrine gland secreting a product comparable with the vitellus ETIENNE RABAUD and MLLE MARIE LOUISE VERRIER The ablation of the swim bladder of the Physostome fishes MLLE DINAH ABRAGAM The specific curves of discharge of normal and cancerous animal tissues charged electrically CHARLES DHÉRÉ and MLLE ANNE RAFFY The infra red radiation emitted by the fluorescence of green leaves when illuminated J WAJZER The static interfacial tension as a function of the concentration of alkali in the saponification of oil MME ANDRÉE DRILHON The alkaline reserve the pH and moulting in the short tailed Crustaceans HENRI VIOLLE The action of sodium ricinoleate on various micro organisms Various strains of human and bovine tubercle bacillus, and various types of Spirochæta were killed by contact with weak solutions of sodium ricinoleate At similar concentrations various diastases were unaffected FRANÇOIS MAIGNON Researches on the mechanism of anaphylactic sensitisation RENÉ LERICHE and RENÉ FONTAINE The present state of knowledge concerning peri arterial sympathectomy after 546 operations

BRUSSELS

Royal Academy (*Bull Classe Sci* 31 No 2 Feb 2 1935) E HENRIOT The antisymmetrical aspect of electromagnetism torque and momentor (2) Extension to case of media possessing optical rotatory power P BRUYLANTS Some observations on the subject of the properties and the structure of maleo and citracononitrile Molecular refractivities suggest that these compounds are not true *cis* nitriles but internal dinitriles possessing a ring structure G BOULIGAND Application of the contingent to obtain the criteria for identical vanishing C LURQUIN On the algebra of eventual variables H GEIRINGER A new method of theoretical statistics (problems in two dimensions) P DEBYE The rotation of the molecules in liquids The theory of the change in the molecular polarisation and Kerr effect in passing from the gaseous to the liquid state is given in terms of a potential energy of orientation of the molecules in a liquid YVONNE DUPONT Th De Donder s thermodynamic synthesis applied to the transverse Nernst and Ettinghausen effects Bridgman s law concerning these effects is extended to the case of irreversible transformations M NICOLET On the presence of argon in stellar atmospheres The evidence is on the whole conclusive as to the presence of argon in certain stars L PONCELET On turbulent movements in the stratosphere disclosed by a sounding balloon The record of an ascent clearly shows two singularities which prove the existence of turbulence in the stratosphere J DE WOLF and L VAN DE STRAETE Maleo and fumaronitrile Methods of preparation and various physical properties of methyl fumarate fumaramide, fumaronitrile and the corresponding derivatives of maleic acid L VAN DE STRAETE Citracono and mesacononitrile Extension of work of preceding paper to these compounds E. RUPPOL Ultra violet absorption spectra of fumaro , maleo , mesacono and citracononitrile The ultra violet spectra of aqueous and methyl alcoholic solutions of the compounds described in the two preceding papers M GHERMANESCO On Fredholm's third theorem (erratum)

CRACOW

Polish Academy of Science and Letters, February 4 S MAZURKIEWICZ and MLLE K SZMUSZKOWICZOWNA Quasi analytical functions (B) M WOLFKE A new method for detecting the neutrino The new method for proving the presumed existence of the neutrino consists in counting the electrons projected from lead by the neutrino either with a Wilson chamber or a Geiger Muller counter S MROZOWSKI The hyper fine structure of the mercury hydride bands A JABLONSKI The negative polarisation of the phosphorescence of molecules adsorbed by colouring matters W SZYMANOWSKI The influence of the concentration of potassium iodide on the duration of the fluorescence of uranine solutions MLLE A WRZESINSKA The variability of the fluorescence spectrum of trypaflavine in glycerol solution S DOBINSKI The influence of the electric field on the viscosity of liquids The change of the viscosity of liquids under the influence of the electric field is due to the action of ions and diminishes or disappears when the liquids are purified W SWIETOSLAWSKI and S MIERNIK The determination of small amounts of moisture in solid organic substances The method is based on the lowering of the temperature of condensation of the vapour of a binary azeotrope by water The accuracy is of the order of 0 003 per cent W SWIETOSLAWSKI M WOJCIECHOWSKI and S MIERNIK The determination of moisture in standard benzoic acid The application of the boiling point method to benzoic acid standard 48*a* of the Washington Bureau of Standards gave a moisture content of 0 0047 per cent MLLE R LUDWICZAK and J SUSZKO Studies on the saponification of the methyl group of quinidine M KSIAZKIEWICZ The zone of the external Carpathian klippes in the neighbourhood of Andrychow (1) The klippes of Inwald and of Roczyny J TOKARSKI Contribution to the knowledge of the hydroclastic elements of the neighbourhood of Czeremosz S BISKUPSKI Chemical and microscopical analyses of the phosphorites from the kulm of the mountains of Swiety Krzyz THAD WISNIEWSKI and MLLE IR REJMENT The mountain element in the hepatic flora of the lacustral region of Suwalki J ZWIEBAUM and M SZEJNMAN Researches on the binuclear cells in cultures of tissues

LENINGRAD

Academy of Sciences (*C R* 1 No 2 3 1935) G LORENTZ Functionals and operations in the spaces of numerical series M KELDYSH and M LAVRENTJEV Contribution to the theory of conformal representation S JANCZEWSKIJ Irregular oscillating properties of the proper functions in the case of differential equations of the fourth order P PAVINSKIJ The exchange interaction between two atomic nuclei M LEONTOVITCH Contribution to the theory of molecular dispersion of light in an unevenly heated crystal N DOBROTIN I FRANK and P CHERENKOV Observations of the night sky luminescence by the extinction method I CHVOSTIKOV and A LEBEDEV Intensity variation of the auroral green line in the night sky M KATZNELSON and M KABATCHNIK The ester of *para* aminobenzoic acid and lupinine O ZVIAGINCEV and A FILIPPOV (1) Occurrence of platinum in sulphurous ores (2) Platinum content of the minerals of sulphide ores E SOTNIKOV and T PALEJ Stability of races of *Aspergillus niger* as regards the production of acid N. **Toropov**: Chemico-mineralogical studies of the aluminates of barium. R. **Belkin**: Interaction of the external and internal factors during ontogenesis in Amphibia (2) The influence of temperature on the metamorphosis of *Amblystoma tigrinum* produced by thyroxin D **Kostoff**: Studies on polyploid plants (5) Fertile hybrids, *Triticum vulgare—monococcum* E **Hasratian** Motor defensive conditioned reflexes in dogs with extirpated cortical motor areas of the cerebral hemispheres A **Lindberg** · Influence of the length of intervals between the applications of conditioned stimuli on the energy of conditioned reflexes S **Krajevoj** and F **Kiritchenko**. New contribution to the investigation of developmental stages in wheat. V. **Sukachev**: *Brasenia purpurea*, Michx in the early tertiary deposits of western Siberia. V. **Redikorzev** · *Apocheiridium rossicum*, sp n. Description of a new pseudoscorpion from Russia. P **Tyurin**: Contribution to the biology of the perch (*Perca fluviatilis*, L) from Lake Chany, western Siberia

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, May 12

British Museum (Natural History), at 3 and 4 30—Capt. Guy Dollman "Mammals" *

Monday, May 13

University College, London, at 5—D H K Lee "The Physiological Effects of Tropical Climate" (succeeding lectures on May 20, 27 and June 3) *

National Institute of Industrial Psychology, at 5 30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1)—Prof Major Greenwood "The Modern Impôrtance of the Temperamental Factor and its Ancient History" *

Armourers' and Brasiers' Company, at 7—(in the Sir John Cass Technical Institute, 31 Jewry Street, E C)—Dr H Moore "Internal Stresses in Metals and Alloys" (succeeding lectures May 20 and 27) *

Royal Geographical Society, at 8 30—Sir Halford Mackinder "Progress of Geography in the Field and the Study during the Reign of His Majesty King George the Fifth"

Tuesday, May 14

Institute of Physics, at 3 15—Annual General Meeting

Eugenics Society, at 5 15—(in the rooms of the Royal Society, Burlington House, W.1)—Prof. R. A Fisher "Eugenics, Academic and Practical"

Gresham College, Basinghall Street, E C.2, at 6.—A R. Hinks "The Astronomy of the Last 25 Years" (succeeding lectures on May 15 and 16).*

Institution of Civil Engineers, at 6.—Annual General Meeting.

Royal Photographic Society (**Scientific and Technical Group**), at 7—Prof Moritz von Rohr "Modern Instruments both for the Accurate Depicting and Correct Viewing of Perspectives or Photographs".

Illuminating Engineering Society, at 7.15—Prof M. Pirani: "Production of Light"

Thursday, May 16

Royal Society, at 4.30—Prof R H Fowler · Bakerian Lecture.

London Mathematical Society, at 5—(in the rooms of the Royal Astronomical Society, Burlington House, W.1).—Prof. E. C. Titchmarsh. "The Zeta-Function of Riemann".

St. Mary's Hospital, London, at 5—Dr. Igor N. Asheshov "Bacteriophage" *

British Science Guild and Engineers' Study Group on Economics, at 5 30—(at the Institution of Civil Engineers, Great George Street, S W 1)—Discussion on "Economic and Social Reform Programmes" Report to be presented by Lieut-Col J V Delahaye

Institution of Electrical Engineers, at 6—Annual general meeting to be followed by talking films of eminent electrical engineers.

Chemical Society, at 8—Discussion on "The Significance of Phosphoric Esters in Biochemical Processes", to be opened by Prof R Robinson.

British Institute of Radiology, at 8—Dr. G Shearer "The X-Ray Microscope" (Presidential Address)

Royal Society of Arts, at 8—Prof A F Barker "The Evolution of the Industrial System in the Far East"

Friday, May 17

Gresham College, Basinghall Street, E C 2, at 6—A R Hinks "The Tercentenary of Robert Hooke" *

Official Publications Received

GREAT BRITAIN AND IRELAND

River Flow Records River Dee (Aberdeenshire), the Records of Water Level, Rainfall and Run-off for the Year 1934 By Capt W N McClean. Pp 8+5 plates (London River Flow Records) 10*s* 6*d*.

Iron and Steel Institute Special Report No 8 Third Report of the Corrosion Committee Pp ix+214+12 plates (London Iron and Steel Institute)

The Institute of Physics Report of the Board for the Year 1934 Pp 15 (London Institute of Physics.)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1547 (T 2859) Experimental Investigation of Boundary Layer Flow, with Special Reference to the Transitional Region. By L F G Simmons and A F C. Brown Pp 18+21 plates 1*s* 3*d*. net No 1612 (I C E 919, 985) Consumption Measurements in Flight with Variable Ignition By J. L. Hutchinson and E Finn Pp 8+15 plates 9*d* net (London H.M Stationery Office)

Stonyhurst College Observatory Results of Geophysical and Solar Observations, 1934, with Report and Notes of the Director, Rev J P Rowland Pp xx+42 (Blackburn Stonyhurst College)

B B C Annual, 1935 Pp 192 (London British Broadcasting Corporation) 2*s*. 6*d*

OTHER COUNTRIES

New Zealand State Forest Service Bulletin No 7 A Phomopsis Disease of Conifers in New Zealand Pp 30 1*s* 9*d* Circular No 35 Forestry in New Zealand Pp 14 (Wellington, N.Z Government Printer)

Southern Rhodesia Meteorological Report for the Year ended 30th June 1934, by the Department of Agriculture Pp. 43. (Salisbury Department of Agriculture)

Brooklyn Botanic Garden Record Vol. 24, No 2 The Twenty-fourth Annual Report of the Brooklyn Botanic Garden, 1934. Pp 158 (Brooklyn, N Y Brooklyn Institute of Arts and Sciences.)

Fiskeridirektoratets Skrifter Report on Norwegian Fishery and Marine Investigations. Vol. 4, No 10 Torskens Gytning · med særlig henblikk på den årlige cyklus i generasjonsorganenes tilstand. Av Erling Sivertsen Pp 29+4 plates (Bergen A.s. John Griegs Boktrykkeri)

Journal of the Indian Institute of Science. Vol. 18A, Part 1 A New Enzyme Preparation. By M. Srinivasan and M. Sreenivasaya Pp 5 10 annas Vol. 18A, Part 2 Extraction of Sap from Plant Tissues By S Rajagopal and A. V. Varadaraja Iyengar Pp. 7–10 8 annas. Vol 18A, Part 3 Isolation and Characteristics of a New Species of Rhodococcus (*R nuciferii*) By A V Varadaraja Iyengar Pp 11–14 8 annas Vol. 18A, Part 4 Addendum to the Paper "Indian Coal Tar". By B. Jagannath Hedge, B Sanjiva Rao and P C Guha. Pp 15–18 8 annas. (Bangalore. Indian Institute of Science)

U S Department of Agriculture Circular No 353 The Dutch Elm Disease Eradication Project, Federal, State and Local Co-operation. By L H Worthley Pp 4 (Washington, D C. Government Printing Office) 5 cents.

Cold Spring Harbor Symposia on Quantitative Biology Vol. 2. Pp. xii+284 (Cold Spring Harbor, N Y. The Biological Laboratory.)

Proceedings of the Academy of Natural Sciences of Philadelphia Vol. 86, 1934 Pp. iii+580+23 plates. (Philadelphia · Academy of Natural Sciences.) 6.25 dollars.

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Large-Scale Research in Crop Production—Cotton*

ORGANISED research in furtherance of industry has, in proportion to the interests involved, developed more slowly for agriculture than for industrial commodities or for processing or for transportation The work of the Empire Cotton Growing Corporation, one of the youngest and now one of the strongest organisations for research on crop production, is, however, an example of bold development The raw cotton position just after the War, when Great Britain was dependent on the United States for a very high proportion of her supplies, led to the founding of the Corporation in 1921 Production in the newer Empire fields (that is, excluding India) has since then increased from 30,000 to 90,000 tons The financial support of the Corporation has come largely from the cotton spinning industry which, by promotion of research throughout its own grave depression, has shown striking faith in science In brief, it is the object of the Corporation "to put the Empire into such a position that it can and will produce, within economic limits, its proper share of the cotton required by the world "

This main objective is easily seen to resolve into a great array of problems Where cotton is a more or less familiar crop, increase of yield and improvement of quality bring up difficult questions of disease, of soil fertility, and in some cases of irrigation But a great increase in the Empire's cotton area is clearly indispensable, and is only possible by extension to territories where cotton has not been grown at all or only scrappily, for simple local use Here are added to the problems of established cotton areas many new, intriguing issues Suitable varieties must be found or made. Labour must not only be trained but also, if possible, made more effective by displacing hand tools—for the available new areas are largely in East and West Africa—by cattle-drawn ploughs and hoes In devising appropriate systems of cropping and cultivation for the new areas lie some of the most important problems Ancient systems, resting on some form of 'shifting' cultivation, do not readily admit a wholly new crop, and that a cash crop, on any extensive scale Further, the terrible menace of soil erosion hangs over orthodox weed-free methods in many places, while maintenance of fertility is a problem of which green manuring, an old, unsolved question of the most progressive European countries, is but a part There are, too, considerable issues in ensuring supplies of seed, in grading, marketing and transport.

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* Empire Cotton Growing Corporation A Review of the Work of the Experiment Stations, Season 1933–34 By Dr J C Willis Pp. 38. (London Empire Cotton Growing Corporation, 1935) 1*s* 6*d*

The Corporation has provided for the study of its problems by setting up stations, twelve in number, which besides working independently, collaborate with the agricultural departments of their territories A post-graduate scholarship scheme has been used to provide a large part of the scientific personnel

This great research organisation is governed by the Director of the Corporation, with advice from a small scientific committee, which meets in London Stations have substantial freedom in determining, appropriately to their circumstances, the balance between primarily scientific and more empirical and immediate investigation A purely scientific research station in Trinidad (not included in the "Review") is maintained for studies in which central effort and the most specialised resources are required

Suitable collaboration and mutual assistance among twelve widely dispersed and variably circumstanced stations demand—perhaps it is the chief need—a most careful provision for interchange of views and experimental results A volume of progress reports is issued every year by the Corporation, but this leaves unsatisfied the needs of a great number who, as contributors to the research fund, or as investigators, or as administrators in the territories concerned, are deeply interested in the realisation of the Corporation's aims It is for them Dr Willis's review, with its admirable brevity and simplicity, is issued

It is natural to find plant breeding the most prominent part of the stations' work, for in new circumstances improved varieties frequently offer the earliest opportunity for agricultural progress A selection made by F R. Parnell, of the Corporation's staff in South Africa, has, under the name of 'U 4', now become famous Its great value arises from its strong, inherent resistance to the jassid (*Empoasca facialis*), an insect which formerly threatened to inhibit cotton cultivation over most of the southern half of the African continent

Dr Willis, in dealing with improvements in agricultural practice, refers to the importance of "work which has a definite bearing, not upon cotton as cotton, but on its satisfactory, efficient, and economical insertion into the general agriculture of the country" This obviously right, though far from common, attitude in research on a single crop, gives to the agricultural studies of the various stations an admirable range and soundness The actual problems are as diverse as the countries in which they occur—Australia, Rhodesia, South Africa, Fiji, Sudan, the West Indies, and many parts of East and West Africa. The Corporation may be assured that an annual review in the form and the style Dr Willis adopts in this first essay will be widely appreciated

Reviews

Evolutionary Morphology of Plants

Primitive Land Plants, also known as the Archegoniatæ By Prof F. O Bower. Pp xiv+658 (London Macmillan and Co, Ltd, 1935) 30*s* net

THE publication of a new work by Prof F O Bower dealing with the Archegoniatæ is an event of importance in the study of the morphology of plants. For Prof Bower, who has contributed largely to our detailed knowledge by his investigations, has never rested content with mere description. He has always aimed at bringing the facts under general conceptions or hypotheses His work has thus never lost the impulse of the evolutionary point of view, whether it has been a direct quest for phyletic lines or, as he here puts it, an attempt "to visualise the Methods of Advance which these primitive Land-Plants appear to have followed in their evolution" That he has retained this aim and the faith that it may be reached is closely connected with his work having been concerned with the Vascular Cryptogams or Pteridophyta, for these present exceptionally favourable material for evolutionary morphology They can be studied apart from the later evolved Gymnosperms and Angiosperms, they are represented by varied living forms and they have a wonderfully good and instructive fossil record.

The Vascular Cryptogams are here considered in relation to the Bryophyta, as was the case in "The Origin of a Land Flora", published twenty-seven years ago The subject matter is the same, but "Primitive Land Plants" is an entirely new work. The changes in interpretation are due to Prof. Bower's responses to the additions in the interval to our knowledge of the facts The book is divided into two parts: Part 1, which occupies two thirds of its length, deals descriptively with the main subdivisions or classes of Bryophyta and Pteridophyta The treatment is objective and general interpretations of the morphology are only foreshadowed These general views emerge into full treatment in Part 2, in the course of a discussion for which the descriptive portion provides the data

The descriptive account of archegoniate plants is written with the clearness characteristic of Prof Bower, and is illustrated by a well-selected set of figures, many of which have hitherto had to be sought in original papers This up-to-date survey will doubtless prove a much needed textbook for students, though this is not its main purpose The "Origin of a Land Flora" was used with great gain in this way, and the present book has the advantage of dealing with both generations in the life-history

Tempting as it is to dwell on the treatment of the various groups as described in Part 1, it seems more desirable to bring out some of the author's general conceptions and conclusions Attention is directed throughout the book to the new light which is thrown on many features of both generations by considering relations of size and form There is further an excellent brief general treatment of the theory of size as applied to the vascular system in Chapter xxviii As regards alternation of generations in land plants, the position taken up remains essentially that of the "Origin of a Land Flora", though modified in details The interesting types of alternation in brown and red algæ are not regarded as bearing directly on the origin of the Archegoniate sporophyte This is still held to be a stage interpolated in the course of evolution between syngamy and meiosis Nor is there any change in principle in the treatment of the prothallus and gametangia or of the embryology The latter leads to the recognition of the primitive spindle, which finds its prototype in the Bryophyte sporogonium, can be connected with Zimmermann's theory of the telome and leads to the increasingly elaborate plant-body of the Pteridophytes. This is seen in its simplest form in the dichotomously branched leafless Rhyniaceæ, and the novelty of the author's evolutionary conceptions becomes evident in considering various progressions from this.

The title of Chapter xxvii, "Axes and Leaves", is intended to indicate that 'leaves' may not be, and indeed almost certainly are not, referable to one type This is generally accepted when the leaves of the gametophyte as well as the sporophyte are under consideration. The more difficult question concerns the simple and often small leaves of the Psilotales, Lycopodiales and Equisetales on one hand, and the large and compound leaves of the Filicales on the other In the "Origin of a Land Flora", the megaphyllous type was derived from the microphyllous, by increase of size and elaboration of the leaf relatively to the stem bearing it A fundamental distinction in origin is now drawn between cladode leaves or megaphylls and microphylls or *Thursophyton* leaves The strong evidence for the interpretation of the fern frond as derived from an increasingly specialised branch-system is clearly stated It explains many details, and leads back to the conception of axis and cladode leaf being referable in origin to a common scheme of distal forking

In emphasising the distinctness of the microphylls from the cladode leaves the alternative term, *Thursophyton* leaves, indicates the weight now attached to the early fossils Diagrams of the spines or leaves of *Psilophyton*, *Asteroxylon* and *Arthrostigma* bring out the facts of construction clearly The origin of such leaves in the transition region of *Asteroxylon* and of the Psilotaceæ is most naturally interpreted as by enation and not by branching On our present knowledge, there is a strong case to be made out for progressions starting from the wholly leafless branch-systems illustrated by the Rhyniaceæ towards the two types of foliar development A further question is raised by the inquiry whether in ferns with their cladode leaves there are parts comparable with the spines or leaves of microphyllous Pteridophyta The dermal appendages of ferns have features in common with the microphylls, and comparisons, which may have morphological importance, can be instituted between them It is pointed out, however, that the resemblances may be homoplastic and not homogenetic

What is brought out by the comparative survey of the vegetative organs of Pteridophyta acquires further significance in the light of the examination of the spore-bearing members in Chapter xxix Again only salient points can be noted The Bryophyte sporogonium, especially as illustrated by that of *Anthoceros*, comes into the comparison not only by way of the problematical *Sporogonites* but also because of the general features of the undoubtedly vascular *Hornea* and *Rhynia* This leads to a conception of the elaboration of form by way of the branching of a sporogonium-like structure The sporangia, terminal in *Rhynia*, may be grouped in leafless strobili as in *Zosterophyllum* Condensation of the ultimate fertile regions of a branch-system gives a natural key to the sporangiophoric condition To this leafless type of plant the enation of microphylls in the region intervening between the rhizome and the fertile *Hostimella*-like region introduces a further complexity, as illustrated by *Asteroxylon* In some advanced Vascular Cryptogams, notably in

Equisetum and *Archæocalamites*, the fertile region consists of sporangiophores borne on a main axis without any associated 'leaves' Comparison with other extinct Equisetales suggests the invasion of this fertile region by microphylls which become a very definite feature of the strobilus A similar explanation is shown to be applicable in the Psilotales and Sphenophyllales The constancy of the relation of sporangium and sporophyll in Lycopodiales presents an evident difficulty, but in this connexion it is possible to point to the condition in *Zosterophyllum*, where large sporangia of Lycopod-type form a strobilus free from leaves While there are no forms showing the invasion of such a fertile region by microphylls, the starting point is illustrated by a known plant

The above is a condensed statement of a new and interesting interpretation of the strobilus of microphyllous Pteridophytes Morphologists will have to refer to the evidence in full as it is given in various parts of the book It should be added that, just as a possible equivalence of the dermal appendages of ferns with microphylls was suggested, so a broad correspondence can be traced between the sorus of ferns and the sporangiophore The parallel can be further extended, and the sorus with its indusium compared to the sporangiophore with its associated microphyll

It is scarcely necessary to follow the combination of the general conceptions, some of which have been considered above, into the organographic analysis of the plant in Chapter xxx and the summary of the whole argument in the concluding chapter Enough has been said to make it clear that this essay, as the author illuminatingly terms it in the dedication to the memory of Dr D H Scott, raises fundamental questions in the morphology of the Archegoniatæ We are led to consider again aspects of these plants that, unless we are to remain content with mere description, demand some evolutionary explanation Prof Bower brings before us the challenge of the facts and the solutions he can suggest These carry great weight from his life-long study of the group, though he would probably be the first to disclaim for them any finality But the play of ideas on the facts as known at present keeps interest alive, and new, clearly expressed conceptions are valuable, whether they come to be accepted or lead to the formulation of alternative views In either case our knowledge is made more coherent, and there is probably no other way in which evolutionary morphology can advance

The value of the conclusions thus lies partly in themselves, but perhaps of even greater importance is their effect as a stimulus to the search for further facts, whether in the comparative morphology of existing plants, in the fossil history or in experimental morphology That our general views and working hypotheses are other and fuller than if this book had not been written more than justifies what is said in a sentence on its wrapper "The author believes that at the end of a long life of research some comprehensive expression of opinion, however tentative and imperfect, would aid students who will carry on the work " It will indeed be recognised by all students of plant morphology that "Primitive Land Plants" adds greatly to the debt which they already owe to Prof Bower for "The Origin of a Land Flora" and "The Ferns"

W H LANG

Israel in the Making

The Heritage of Solomon an Historical Introduction to the Sociology of Ancient Palestine By John Garstang (Herbert Spencer's Descriptive Sociology, continued by his Trustees, Vol 3) (Published for Herbert Spencer's Trustees.) Pp xv + 439 + 4 plates (London Williams and Norgate, Ltd , 1934) 20*s* net

THIS contribution to the "Descriptive Sociology" planned by Herbert Spencer, and continued by his Trustees, is the third volume of the new octavo series, and a welcome contrast to the earlier folios But it seems to have been constructed round the Sociological Index (p. 395) of passages in the earlier books of the Old Testament, and consequently tends to lapse into minute enumerations of archæological or administrative detail, reminiscent of *Numbers* and *Deuteronomy* rather than of *Exodus*. Much of the topographical and strategical material of the author's recent *Joshua, Judges* has, however, been incorporated, and a summary of modern critical hypotheses and interpretations of Hebrew traditional history Perversely, however, Prof Garstang "carefully abstained from using" other people's "books as works of reference" and consequently has made some mistakes from which better acquaintance with the literature might have saved him

Prof Garstang's own wide experience of life in Palestine and of the 'methods and practice' of excavation furnish him with some interesting parallels and illustrations, but a characteristic inability to come to the point makes the book disappointing to use The 'J' and 'E' documents "refer most nearly to contemporary events" (p. 12), but to what events ? And what is the "accepted theory" on p 339 ? "Three vast areas" (p. 13) are "peopled by a more or less kindred stock", but *what* areas, and *which* stock ? The Canaanites (p 23) "were possessed of a formidable arm of war", but we have to wait to learn (p. 108) that their "chief offensive arm" was the chariot, and that Israel had it not. Allusions (p. 186) to "money", "cash" (p 67–8) and "silver currency" (p 86), to an "arterial road" (p 339), to "democracy" in Gideon (p 113) and Philistia (p 257), to "theophoric names" (p 156), to "a kind of maize" (p 324) need explanation in a book intended to be popular on the other hand, it is unnecessary to explain 'cuneiform' more than once Oaxos is not on the coast of Crete, and Zagros not in Crete at all (p 231) unless Zakro is meant If "no distinctively Philistine interments have been recognized" how does the "crater-vase suggest cremation" (pp 234, 240, 243), seeing that this form is common in burial-chambers in Phœnicia, Cyprus and the Ægean ? Surely the "only known attempt to represent Israel's God" on a coin should have had an illustration or at least be identified by reference to one It does not help much to visualise Solomon's buildings, to be told, as in the Authorized Version, that the doors "like the posts, were 'square in prospect' ", and is it seriously suggested that the private chapels built for Solomon's wives "opened thinking minds to a broader conception of a Godhead that should comprehend all gods" ?

Of Solomon himself, Prof Garstang thinks poorly Born in the purple, he dissipated his "heritage", and provoked reaction against monarchy and monotheism alike What is nowhere explained, however, is the unique fame of his "Wisdom", nor is there any serious attempt here to reconstruct the art, apart from the mere structure, of his Temple. Here, at all events, an excavator might be allowed to guess.

J L MYRES

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1935 (Published for the Universities Bureau of the British Empire) Pp xxxi+1057 (London G. Bell and Sons, Ltd , 1935) 15*s* net

THE publication of the 1935 issue of this annual marks the attainment of its twenty-first year Like the goddess Minerva, with whom it has a certain affinity, being a yearbook of the learned world, it never knew infancy, but it bears to-day unmistakably the stamp of maturity It still retains its original characteristic features . (1) a section for each university containing a directory of the officers and members of the staff (the teaching staff being arranged under subject headings), general information about the university's organisation, regulations, etc., and reports of events of outstanding interest which occurred during the past year, (2) an index of names covering all the universities. To these have been added five introductory chapters dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, a large number of appendixes containing a vast amount of information, conveniently displayed, about admission to universities, open post-graduate scholarships, professional associations, centres of scientific and industrial research and various other matters and a general index

The introductory chapters, dealing with the universities' histories, regulations and practice, are readable essays, striking a happy mean between the slap-dash and the unduly elaborate, and are kept up to date by frequent re-editing Of the appendixes, one shows the countries of origin of university students in the British Isles in greater detail than the returns of the University Grants Committee It appears that last year more than five thousand students came from abroad from continental Europe, 1098, Asia 1,739, Africa 888, America 1,070, Australia 355 Of the European students by far the largest quota came from Germany—436 France sent 81, Norway 47, Switzerland 45 and Holland 42 Another gives a useful short bibliography of works relating to universities When the Yearbook was first compiled it was hoped to arrange all its information in so orderly a fashion that no index other than the index of names would be needed The ideal was adhered to in theory too long after it had become obviously unrealisable in practice In recent years a good general index has been perfected A perusal of the Yearbook, necessarily rather cursory, has brought to light nothing to which exception could reasonably be taken except, perhaps, in the Durham Colleges section, a disconcerting entry "For early history, see Yearbook for 1929"

The Yearbook has suffered through the untimeliness of its birth—six months before the outbreak of the War—and though its valiant struggle for existence in the stormy period 1914–18 was successful, it found itself thereafter in a world in which the dominance of nationalism has unfortunately not been confined to the political and economic spheres A generation ago the Yearbook would have had a much larger circulation in foreign countries than it has to-day. Even within the Empire its circulation is not nearly so large as its potential utility should make it The preface characterises its contents as "such information as may be of interest to members of universities and colleges, to Government departments, clubs, schoolmasters and the public generally" But until public librarians and, it may be added, writers on university topics in the public press, recognise its merits more generally than at present, its utility to the general public will remain almost wholly latent.

Short Notices

General Astronomy. By Dr. H. Spencer Jones. Second edition. Pp. viii+437+28 plates. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

SINCE the year 1922, when the first edition of the Astronomer Royal's "General Astronomy" was published, the progress of the science has been truly remarkable. Naturally this cannot be said of all that broad field where advance has been slowly and laboriously consolidated by centuries of patient observation. There is a very wide region where methods and ideas are static. They retain their importance, but descriptions of them once given do not call for constant revision. There is, on the other hand, a part of the science, chiefly in stellar astronomy, where the application of modern physical theory has changed the scene, and ideas are in a state of flux.

The second edition of the Astronomer Royal's work preserves an account of those parts of the subject which may be regarded as standard, but it also includes a new treatment of that domain where progress has been most rapid. The author has succeeded in conveying a remarkably comprehensive view of the present state of the science. It is, of course, a trustworthy picture, perhaps a little overcrowded with detail, but on the whole well proportioned. It must be felt that the work in its new form approaches the limit of what can be reasonably compressed within the bounds of a single volume.

An excellent account of the ideas associated with an expanding universe is included. Here no hesitation is shown in accepting the crude Doppler interpretation of the nebular recession. The difficulty presented by the evolutionary time-scale is clearly stated (§ 276). But no mention is made of such possible ways of escape as that suggested by Prof. W. D. MacMillan in his letter in NATURE of January 16, 1932, p. 93. Can it be that the abstruse is now preferred for its own sake to the simple ?

Biomathematics: being the Principles of Mathematics for Students of Biological Science. By Dr. W. M. Feldman. Second edition, reset and enlarged. Pp. xviii+480. (London: Charles Griffin and Co., Ltd., 1935.) 25*s*. net.

THE first edition of Dr. Feldman's book appeared in 1923 and filled a serious gap in mathematical literature. It has now been out of print for some years, and a new edition is to be warmly welcomed, there being still no other book covering the same field. The new edition has been extensively revised and many errors have been eliminated. New chapters, on nomography and on the estimation of errors, have been added. The chapter on biometry has been enlarged, and now forms perhaps the best introduction to this important subject for the biologist with only a small knowledge of mathematics.

Dr. Feldman's choice of matter is good, his exposition is clear, and many of his biological examples are excellent. But it is sincerely to be regretted that he has not sought the criticism of a competent mathematician with regard to the details of his work. Incomplete and misleading statements are not uncommon, and most of them could be eliminated without adding to the difficulties of the reader. The definition of a convergent series on p. 73 is false, as is the statement on p. 124 that the graphs of all cubic functions are *S*-shaped. Examples of such errors could be multiplied. It is to be hoped that a third edition will at some time be called for and that Dr. Feldman will remove these blemishes from his valuable book.

The Journal of the Institute of Metals. Vol. 55. (No. 2, 1934.) Edited by G. Shaw Scott. Pp. 304+17 plates. (London: Institute of Metals, 1934.) 31*s*. 6*d*. net.

THIS volume contains eighteen papers presented at the autumn meeting of the Institute of Metals held in Manchester, together with the thirteenth Autumn Lecture. The latter, delivered by Dr. J. L. Haughton, took the form of a memorial tribute to the late Dr. Walter Rosenhain, and gave an outline of Rosenhain's outstanding contribution to physical metallurgy during his long tenure of office as superintendent of the Metallurgy Department of the National Physical Laboratory.

The most outstanding contribution to metallurgical knowledge contained in this volume comes from the recently founded International Tin Research and Development Council. Mr. D. J. Macnaughtan, the director of research, contributes a paper on "The Improvement of White Bearing Metals for Severe Service", while three other papers sponsored by the same body deal with the behaviour of these alloys under various deformation tests, and present some valuable fundamental data. The very full discussion on these four contributions makes this volume particularly valuable as a work of reference on an important group of alloys.

Bergtechnisches Taschenwörterbuch. Teil 1: *Englisch–Deutsch.* Von Prof. W. Schulz, Prof. H. Louis und Bergassessor Goethe. Pp. 90. (Essen: Verlag Gluckauf G.m.b.H., 1934.) 4.20 gold marks.

THIS is a highly specialised glossary of technical terms used in mining, mining engineering and mining geology. It includes, in addition to technical and scientific terms in general use, special terms peculiar to particular localities. This feature should make it particularly useful to German-speaking individuals who wish to read English mining literature, even though the glossary is not free from inaccuracy and lacks some terms which ought to have been included. The complementary German–English part of this handy pocket glossary is promised.

The Industrial Transition in Great Britain

By DR. K. G. FENELON

DURING the post-War years, important changes have been taking place in the distribution of industries and employment in Great Britain. Some of these are well known and the effects are fully appreciated, but concerning others, facile generalisations are frequently made, and this despite the fact that there are few economic problems in which the statistical information available is so abundant.

During the eleven years 1923–34, unemployment has fluctuated from somewhat less than 9 per cent to about 23 per cent, whereas in pre-War days unemployment varied between 2½ per cent in the best of times to a little more than 10 per cent in the worst. Pre-War unemployment statistics, it is true, are much less adequate than those available to-day, and also certain persons now regarded as unemployed might not have been so regarded before the War, but at any rate it is clear that unemployment is nearly double that of pre-War days. It would be a mistake to imagine that the figures of recent years represent a permanent state of unemployment of something like two million workers, because in actual fact unemployment has been spread in each of these years among five or six million workers—that is, about half of the insured population—some suffering little from unemployment and others severely. There are two kinds of unemployment, one intermittent, the other prolonged, and it is on those in the latter category that the most tragic consequences of the industrial transition have fallen.

How are we to account for the change in the proportion of unemployment since the War? Is it due to the introduction of machinery, and must the inevitable result of scientific progress be that more and more persons will be thrown out of employment? Past experience does not bear this out as inevitable. During the nineteenth century—despite enormous technical progress and a great increase in population—unemployment did not steadily become greater. The popular view that machines are steadily increasing production and at the same time steadily throwing men out of employment cannot be sustained by reference to statistics of production and employment. For example, between 1924 and 1929 the index of production rose from 100 to 111·8 and the employment index increased from 103·8 to 110·5. Nor would it seem, taking industry as a whole, that men are being displaced by women, whatever may be the case in particular industries or occupations. Census returns show that the occupied female population in England and Wales accounted for 30·4 per cent of the total occupied population in 1881, for 29·7 per cent in 1911, for 29·5 per cent in 1921 and for 29·8 per cent in 1931.

After the War, a readjustment from war- to peace-time demands had to be effected, and even more difficult has been the problem of reshaping the structure of British industry to meet the decline in exports which has resulted from industrial development in foreign countries, the imposition of all kinds of restrictions on foreign trade, and technological changes such as the displacement of coal by oil fuel especially in shipping.

Furthermore, the slowing down of the rate of increase of population in so many countries has tended to shift demand from primary to secondary industries, and it is no longer possible for the basic industries providing ordinary necessaries of life to expand at the same rate as was formerly required by ever-increasing populations. These various changes have had severe reactions on British foreign trade, since a disproportionate amount of our industrial resources were engaged in the production of primary commodities.

The changed fortunes of the various industries are strikingly brought out by figures for the years 1923–34 relating to the number of insured persons in employment issued by the Ministry of Labour and published in the *Ministry of Labour Gazette* for December last (London: H.M. Stationery Office), from which the following figures have been extracted. Since both 1923 and 1934 were years of incipient recovery after a period of depression, a comparison between them would seem to be permissible, provided it is borne in mind that the insured population increased in this period by a little more than 16 per cent.

Taking first the depressed industries, those which have suffered a loss in employment of upwards of 10,000 persons each since 1923 are listed in Table 1, fluctuations in employment being shown by means of index numbers for the different years.

Coal mining has shown the greatest contraction owing to loss of export markets, economies in the use of fuel and other causes. The iron and steel trades, on the other hand, have made a marked recovery in recent years owing largely to the tariff. Practically all industries show some improvement in 1934, with the exception of cart and carriage building, which has suffered from the continued development of motor transport.

In marked contrast are the expanding industries, the more important of which, from the point of view of additional employment afforded, are set out in Table 2

Altogether, the expanding industries have given employment to the equivalent of all those displaced since 1923 from the declining industries and have provided employment for nearly a million persons in addition In these industries, many of the factories recently built are not inferior to any in the world in respect of equipment, layout or technique

Table 1
Contracting Industries Great Britain and Northern Ireland

Industry	Number Employed		Index Number of Employment (1923 = 100)*			
	June 1923 Aged 16 and over (Thousands)	June 1934 Aged 16-64 (Thousands)	1925	1929	1932	1934
Coal Mining	1,212	623	75 8	74 0	52 7	53 0
Cotton	445	360	117 7	109 0	79 8	81 9
General Engineering	526	444	103 9	105 8	77 3	87 7
Woollen and Worsted	251	181	81 7	85 2	70 7	74 9
Shipbuilding and Ship Repairing	151	81	103 6	108 9	46 4	55 5
Railway (Non Permanent Service)	179	121	88 3	76 1	65 6	69 9
Iron and Steel	167	127	88 1	89 6	54 0	79 2
Marine Engineering	51	33	94 0	105 9	42 2	65 2
Boots, Shoes, etc	129	112	100 6	93 1	85 6	89 4
Textile Finishing	102	86	111 2	102 8	84 5	87 7
Jute	36	20	98 4	98 2	56 3	58 6
Pig Iron (Blast Furnaces)	26	12	75 2	80 7	42 6	51 0
Carriages, Carts, etc	24	12	92 3	74 0	61 9	52 2
Dress Making and Millinery	110	98	92 0	91 7	87 7	89 2

* A direct comparison between 1923 and 1934 is not possible owing to administrative changes in the insurance scheme in 1927, but the index numbers are based on estimates which serve to link up the figures before and after 1927

Further information regarding industrial development has recently been published in a Survey issued by the Board of Trade, which shows that 463 new factories employing 29,500 persons were established in 1933, of which 220 were located in Greater London, 94 in the north-west of England and 63 in the Midlands In the same year, there were 95 factory extensions, while 409 factories were closed down Only three of the new factories represented transfers from the north to the south, and of these, two were aircraft factories The growing industrialisation of the south of England has been due not to the transfer of factories from the north, but rather to its success in attracting new industries Moreover, its typical industries are luxury trades or light industries which have been less hard hit than the old-established industries of the north.

Table 2
Expanding Industries Great Britain and Northern Ireland

Industry	Number Employed		Index Number of Employment (1923 = 100)			
	June 1923 Aged 16 and over (Thousands)	June 1934 Aged 16-64 (Thousands)	1925	1929	1932	1934
Distributive Trades	1,181	1,801	116 9	136 9	149 0	155 4
Building	626	790	112 6	126 8	106 2	132 5
Hotels, Restaurants, etc	233	359	117 6	136 3	141 8	156 7
Tram and Bus Services	105	174	110 2	147 5	167 0	170 2
Motor-Vehicles, Cycles and Aircraft	174	246	116 4	134 4	114 4	143 2
Local Government	228	295	104 7	120 1	133 9	139 6
Electric Cables, Lamps, Apparatus etc	65	122	116 4	139 3	158 5	189 3
Other Road Transport	123	176	113 2	136 0	138 5	147 0
Public Works Contracting	103	153	125 1	136 0	188 0	154 7
Printing, Publishing, etc	215	257	107 9	119 7	122 1	122 5
Laundries, Dyeing and Dry Cleaning	101	143	110 3	131 1	136 5	143 6
Entertainments and Sports	52	92	113 7	130 7	155 5	180 9
Professional Services	104	141	105 9	115 6	126 2	138 0
Furniture	87	118	110 5	135 2	126 9	140 9
Commerce, Banking, Insurance, etc	217	246	98 6	103 4	107 4	114 2

The economic transition which is slowly working itself out becomes more apparent if the expanding industries are classified in groups as follows (1) distributive trades and road transport , (2) building and public works contracting, including the construction and provision of materials for houses, shops, public buildings, roads, drainage and other communal services , (3) administrative and organising services, including those of local government, insurance, banking, education, health, office employment and scientific research . (4) new industries and the manufacture of specialised products.

The changes in industrial structure revealed by the statistics reflect deep-seated economic and social changes in the life of the community As examples we may refer to housing, the great development of which is revealed by the fact that between 1923 and 1933 inclusive, some 1,800,000 houses have been built in England and Wales. The spread of leisure has led to a marked expansion in entertainment and sport, while changes in social and domestic habits account for the development of bus travel, the growth of restaurant and hotel businesses and the expansion of laundry and similar trades which provide services formerly carried on in the home

The new manufacturing industries are much more numerous than is commonly supposed, though the development of many of them is hidden under the generic names in the Ministry of Labour's list In the development of new industries, or the recent expansion of the old-established trades, scientific discovery or the application of science has played an important part. A long list of such products could be given, but it must suffice to mention rayon; aircraft; motor-cars, electric cables, lamps, motors and apparatus, radio, neon signs, photo-electric apparatus, pharmaceutical chemicals; detergents, synthetic resins and other plastic materials, cinematograph films, refrigerators; solid carbon dioxide, chromium plating, cellulose products, and canned foods Indeed, the extent to which scientific research is transforming methods of production is seldom fully realised, and, as was stated in a report of the Department of Scientific and Industrial Research, "in nearly every industry to-day, movements are on foot to apply old materials to new uses or to discover uses for new products"

In rayon, the relation of science to industry is conspicuously close, and this industry has made rapid progress in those countries which possessed a well-developed chemical industry. Other thriving new-comers are the plastic industries, the products of which are now extensively utilised not only for accessories of all kinds, but also in the manufacture of silent gear wheels and in chemical engineering, where their resistance to boiling acids and corrosive fumes are of value Canning is another industry which has recently made rapid progress in Great Britain, expanding its production from about 2–3 million cans in 1925 to more than 100 million cans in 1931 Special problems had to be overcome on account of the high acid content of British fruit, and the difficulties in preserving the colour and flavour. Many ingenious machines have been constructed by British manufacturers for this industry

In connexion with the building-up of new export trades, scientific applications are an essential asset Specialised products, combining high quality with skilled workmanship, are frequently assured of a ready sale overseas, such as has been achieved by British manufacturers of light aeroplanes, motor-cars and electrical apparatus An interesting illustration of the advantages of scientific specialisation in export industries is the almost exclusive utilisation of British photographic and projection lenses in the film studios of Hollywood.

The Professors of the Royal Institution

By THOMAS MARTIN

BY the election on May 7 of Sir James Jeans as professor of astronomy in the Royal Institution, its members have exercised a privilege which has not been used since 1863 Faraday was then the Fullerian professor of chemistry, but he was in his declining years, and Dr (afterwards Sir Edward) Frankland was elected to a separate professorship of chemistry. Frankland discharged the duties until shortly after Faraday's death in 1867, when Odling became the Fullerian professor and Frankland's professorship was allowed to lapse. The other 'elected' professorship in the Institution at the time, that of natural philosophy, had been established ten years earlier, and was not so short-lived. It was created for John Tyndall when he went to the Institution in 1853, to become the friend and colleague of Faraday in the last fourteen years of his life; and it has continued by election and re-election to the present day.

Lectures on scientific subjects, to be given in a lecture room with the most up-to-date facilities for experiment and demonstration, were a part of the original scheme drawn up in 1799 by the founder, Benjamin Thompson, Count Rumford; and when Rumford's proposals were adopted and the Royal Institution of Great Britain came into existence, the "teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life" was recited as one of its objects in the Royal Charter granted by King George III. The lecture room was constructed, under Rumford's personal supervision, at the house which had been purchased in Albemarle Street, and the procedure to be followed in appointing professors and lecturers was laid down in the by-laws given to the new Institution. The professors were to be elected annually by ballot, and a new professorship could be established at any time, by resolution proposed by fifteen members, which must be carried at one general monthly meeting and confirmed at the next.

The first of the Royal Institution professors was Dr. Thomas Garnett Trained as a physician, Garnett had already established a reputation in his profession and as lecturer at Anderson's Institution in Glasgow when, in 1799, he accepted the invitation conveyed by Rumford to join the new institution in London He was elected professor of natural philosophy and chemistry, and on his arrival in December, entered with enthusiasm on his varied duties, but his tenure was not destined to be a long one After some initial success with his London audience, he found himself handicapped by ill-health, by a certain diffidence as to his own powers, and by his north country accent Moreover, he worked under the critical eye of Count Rumford, who lived at the Institution at the time, and personally supervised every detail of its activities It is not surprising that causes of difference appeared In Rumford's view the lectures given by the professors were those they were requested to give, and the experiments they made were those they were directed to make, by the Managers and the various committees The work of the professors was but a part of the whole The Institution, with its library, its workshops, its school for training workmen and mechanics, its repository for models and inventions, was formed for "diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements". It was a part of the philanthropical activity of the day, an attempt to bring to the working classes a knowledge of the useful applications of science.

Garnett found the difficulties of his position too great for him ; and resigned his professorship in June 1801. Before he left, a lecturer in chemistry was appointed to share the work Rumford, writing of the new appointment to his daughter Sarah, in America, said · "We have found a nice able man for his place as lecturer, Humphry Davy" ; and in March 1801, Davy was brought from Dr Beddoes' Pneumatic Institution at Bristol, the place of his experiments on nitrous oxide, to begin the career of exposition and research which was to bring fame to himself and to the Institution in which he worked

To begin with, Davy, then only twenty-three years of age, was in a junior position, and when Garnett resigned, a new professor of natural philosophy was elected, the Quaker physicist, physician and Egyptologist, Thomas Young Thus, almost at the outset, the Royal Institution had associated in its work two men, Young and Davy, whose names are among the greatest in English science Young was engaged at the time on those papers on the theory of light and colours, in which he states his conclusion that "radiant light consists in undulations of the lumniferous ether" and explains the phenomena of interference by means of the wave theory. Although Young was, according to Davy, a most amiable and good-tempered man, his somewhat severe and didactic manner as a lecturer gave him no great success with popular audiences He held his professorship for only two years, and then retired, to devote himself to his medical work and other pursuits

Davy became the professor of chemistry, and his work, more than that of any other man, determined the lines on which the Royal Institution was to develop In the lecture theatre, he possessed all those qualities which Young lacked He infected his audiences with his own enthusiasm. Such was the charm of his personality and the eloquence of his discourse that he made his scientific lectures one of the fashionable amusements of London. Interest in him was heightened by the discoveries he soon began to make in the laboratory, in particular, those on chemical decomposition by means of the electric current, which enabled him to prepare sodium, potassium and other elements, until then unrecognised Later came the Continental tour, with Faraday as his assistant, and the discovery of iodine in Paris, and, on his return to the Institution, the invention of the wire gauze safety lamp for miners

Davy's activities in the laboratory and the lecture theatre established the traditions which have ever since characterised the work of the Royal Institution, of research inspired and largely carried on by the resident professor, and exposition, aided by all the resources of experiment, in terms suited to the layman as well as to the man of science. The Institution continued to attract the "higher ranks of society" whom the early Managers had wished to interest in it as a missionary enterprise depending on their support, but it became also a scientific centre, a place of original research in the problems of pure science which interested the professors Its scope had become at once wider and narrower than the original intention. The training of mechanics, the construction of kitchens, of models, and other measures for introducing scientific improvements for the benefit of the lower classes, were dropped ; although the Managers responsible for the change consoled themselves with the thought that the poor must surely benefit indirectly from the useful activities to which the upper classes of the metropolis could now devote their leisure Count Rumford, soon after Davy's arrival, had fallen out with the other Managers, and gone to live in Paris, whence he grumbled by letter to Sir Joseph Banks at the change of plan in the institution he had founded.

Davy continued in his professorship until 1813. In the previous year he had been knighted by the

Prince Regent, and now, on his marriage to the wealthy Mrs. Apreece, went to live away from Albemarle Street. He was made honorary professor, and although he gave no lectures, continued to work in the laboratories for some years after. Early in this year he did one of his greatest services to the Institution by engaging Michael Faraday, a bookbinder's apprentice who had shown some interest in science, as his assistant

The new assistant soon proved his worth, and began the progress which made him eventually Davy's successor, and the connexion with the Royal Institution which was to extend over fifty-four years His duties were to assist Sir Humphry in his researches and to attend on the other professor and lecturers W T. Brande had taken Davy's place as professor of chemistry, and Faraday's first opportunity of demonstrating his powers as a lecturer in the Institution came some years later, when he was called upon to take Brande's place in an emergency.

Faraday's training in his years as Davy's assistant made of him a good chemist and a skilled experimenter. His first attempts at research of his own were naturally on chemical problems, and early successes were the discovery of new compounds, including in particular "bicarburet of hydrogen" (benzene) The news of Oersted's experiments at Copenhagen set Davy to work on electromagnetism, and stimulated scientific interest all over Europe Faraday, following the developments closely (since his tour in 1813–15 in France and Italy with Davy he knew some of the men whose papers he was reading), had by 1821 made his own contribution to the subject by his discovery of the electro-magnetic rotations It was the beginning of his electrical researches.

The audiences in the lecture theatre discovered, too, that the young assistant had powers of his own Brande, who retained his professorship until 1852, was not, it seems, an inspiring lecturer Faraday, whose methods were less impulsive than those of Davy, had fluency and address at the lecture table, with a genius for apt experiment, and as the years went by he outshone his former master in his ability to fill the lecture theatre and stir in his audience some reflection of his personal enthusiasm.

In 1833 a new professorship was established, of a different kind from the others John Fuller, a wealthy landowner and member of Parliament, made a gift of money for the endowment of what was called the Fullerian professorship of chemistry, the appointments to which were to be made by the Committee of Managers, and were not subject to annual re-election by the members. Faraday became the first Fullerian professor, and occupied the chair until his death in 1867.

It is difficult to speak of Faraday's professorship in a few words It may be said that for nearly forty years, from the moment when in 1825 he became Director of the Laboratory following Davy's statement that "he considered the talents and services of Mr Faraday, assistant in the laboratory, entitled to some mark of approbation from the Managers", he carried the Institution on his shoulders. He upheld and extended the traditions which Davy had originated Two of the characteristic activities, the Friday evening discourses and the Christmas juvenile lectures, owe their inception almost entirely to Faraday To his audiences, he was without a rival in his mastery of the arts of exposition and demonstration by experiment His discovery of electromagnetic induction and his researches in electro-chemistry and electrostatics made him the first man of science of his age

Fuller had endowed a second professorship in 1834, of physiology Unlike that of chemistry, the Fullerian professorship of physiology was to be held for a fixed term of three years. P M Roget was the first professor, and he has been followed by a line of distinguished men The list includes the names of T H Huxley, Sir Richard Owen, Sir Michael Foster, Sir Edwin Ray Lankester, and more recently Sir Charles Sherrington, Sir Arthur Keith and Sir Grafton Elliot-Smith

Tyndall owed his connexion with the Institution to the favourable impression he made when, as a young physicist of promise, after a period of work in Germany, he was invited to give a Friday evening discourse His election in May 1853 as professor of natural philosophy followed, and the later years at least of his professorship must be within the memory of many now living. It is said that he and Faraday worked together in the closest harmony, and that the relations of the older to the younger man resembled those of a father to a son On Faraday's death in 1867, Tyndall followed him as the resident professor, and lived at the Institution until his retirement in 1887 He did valuable experimental work on the radiation and absorption of heat by gases and vapours, and his discovery that bacteria will not breed in dust-free air has been of great importance; his work on sound was done as scientific adviser to the Trinity House, in which office he succeeded Faraday He is perhaps best remembered as an expositor, for his animation and lucidity as a lecturer and for the felicity of his style as a popular writer on science.

William Odling, who succeeded Faraday as Fullerian professor of chemistry, resigned in 1873, after five years. He was followed, for another period of five years, by Dr J. H. Gladstone, who in turn was succeeded, in 1877, by Professor (afterwards Sir James) Dewar. This was the beginning of another long tenure, for Dewar held the professorship for forty-six years, until his death in 1923; and from 1887, after Tyndall's retirement, he lived at the Institution as the resident professor.

Dewar's matchless skill as an experimenter, the fame of his researches, and of his Friday evening lectures with their carefully prepared and rehearsed demonstrations, are well known and remembered. In the Royal Institution laboratories, with apparatus often on an engineering scale, he liquefied the so-called permanent gases, and produced them for the first time—oxygen, hydrogen and air—in quantities sufficient for experiments on the properties of materials at the very low temperatures he reached; he invented, as a container for the cooled gases, the 'thermos' or Dewar flask; and he developed the method, of great technical importance, of making high vacua by using the great absorbing power for gases of charcoal cooled in liquid air. These are but the best known among his achievements. To quote the words of a distinguished contemporary: "He was . . . in no way less successful than his predecessors, Young, Davy and Faraday, in adding to the reputation these pioneers created for the Royal Institution as a centre of scientific discovery and invention." It may be added that the recent lamented death of Lady Dewar is a reminder that not the least important of the Dewars' services to science was given as host and hostess in their house at the Institution.

Since Tyndall, three physicists of great distinction have held the professorship of natural philosophy who have also been, in turn, the Cavendish professor of physics at Cambridge. The late Lord Rayleigh, soon after his retirement from Cambridge, accepted the invitation to the chair at the Royal Institution, and held it until 1905; when he was succeeded by Sir J. J. Thomson. The present professor, Lord Rutherford, took up the duties in 1921. The rules prescribed at the beginning of the Institution for the election of professors are still followed; and thus it is that Lord Rutherford, as an 'elected' professor, must seek the suffrages of the members once a year, while Dewar's successor in the endowed Fullerian professorship of chemistry, the present resident professor, Sir William Bragg, does not do so.

Obituary

MR. C. F. CROSS, F.R.S.

MR. CHARLES FREDERICK CROSS, who died in his eightieth year on April 15 at Hove, where he had lived in retirement for some years, left us indebted to him for a life devoted to a most difficult and unpromising branch of chemical research, rewarded by an epoch-making discovery, which is represented in Great Britain to-day by an artificial silk industry with a market capitalisation of more than £70,000,000. He was educated at King's College, London, the University of Zurich and Owens College, Manchester. In 1879, his work on the cellulose group commenced with a study of jute, and later, in association with Mr. E. J. Bevan and Mr. C. Beadle, he started the well-known business of Cross and Bevan, consultants to the paper trade.

It is difficult to estimate the number of papers on the chemistry of cellulose published by Cross and his collaborators; these date from 1880 until 1920, and appeared in the *Journal of the Chemical Society*, *Journal of the Society of Dyers and Colourists*, *Berichte*, *Phil. Mag.*, *Bull. Soc. Chim.*, and many less-known publications. In these and in his textbooks, he has left us a mine of information and, as Prof. H. E. Armstrong has pointed out, the mystic character of some of his explanations must be ascribed to the intangible nature of his subject. Fulfilling the functions that it does in the plant, cellulose is on the border-line of living substances itself, and is liable to alter with every change in conditions to which it is subjected. His suggestion that it is an 'amphoteric electrolyte' hides a complexity of behaviour that has not been much illuminated by more modern advances in chemical language.

In 1892, Cross discovered that, by virtue of the alcoholic properties of cellulose, a soluble xanthate could be obtained on reaction with caustic soda and carbon disulphide. Working at Kew with Stearn and Topham, who were at first interested in the application of the new discovery to the manufacture of electric lamp filaments, the practical difficulties in spinning a continuous textile fibre were overcome, and the viscose silk industry was born.

At first, the solution of cellulose xanthate was expressed through a number of fine holes into a solution of ammonium sulphate, and the use of an acid bath, which resulted in the formation of a cellulose thread in one operation, was not arrived at until years later. The reception of the thread in a centrifugal box, which collected, drained and twisted it in one operation, due to Topham, has remained the standard practice up to the present day. In 1905, manufacture was started by the firm of Courtauld at Coventry, and the writer, then in charge of the chemical department, has a lively recollection of Cross, who took a great interest in the new venture, with his interesting suggestions, cheery sporting manner, wide culture and artistic interests.

Recognition of the value of Cross's work came later; in 1917 he was elected fellow of the Royal Society, in 1916 he received the medal of the Society of

Chemical Industry and in 1918 the research medal of the Worshipful Company of Dyers. He was elected president of the Society of Dyers and Colourists in 1918, and received the Perkin Medal in 1923.

SIDNEY S. NAPPER

COLONEL W. G. KING, C.I.E.

COLONEL WALTER GAWEN KING, late of the Indian Medical Service, died at his home at Hendon on April 4 at the age of eighty-three years. He graduated M.B. and C.M. in 1873 at the University of Aberdeen, where he also took the D.P.H. in 1888. Soon after qualifying, and before his twenty-third birthday, he entered the Indian Medical Service, in which he passed the next thirty-six years of his life.

On reaching India in 1874, King was posted to the Madras Presidency and, after two years military service with an Indian regiment, was transferred to civil employment, in which he quickly distinguished himself for his active work in the great famine of 1876–77 and the terribly severe cholera epidemic which accompanied it. This experience made him decide to devote his life to preventive medicine, and it is chiefly for the remarkable work which he did in this sphere during a succession of appointments as inspector of vaccination, deputy sanitary commissioner and sanitary commissioner of the Madras Presidency and later as inspector general of civil hospitals and sanitary commissioner of Burma, that his name will go down to posterity as the leading pioneer of public health in southern India.

King's great merit was that at a time when smallpox, cholera and malaria were the three chief scourges of India, and when the scientific world knew nothing of the causes of cholera or malaria, and, therefore, knew nothing of their prevention, he set to work to organise scientific investigations for the benefit of public health and did not pause in the task until the goal he aimed at was attained. At that time, bacteriology was in its youth and the modern sciences of tropical protozoology, helminthology and medical entomology were in their earliest infancy or were as yet unborn. The malaria parasite was not discovered until 1881, and the fact that it is spread by mosquitoes not until 1897. The cholera vibrio was not discovered until 1883. Smallpox, however, could be controlled because a prophylactic was already available and the only problem to be solved was how best it could be applied. In Madras, vaccination with animal lymph instead of with human lymph was successfully established in 1880–81, but more than ten years were to elapse before a satisfactory method of preserving the lymph under tropical conditions was devised. King's well-planned and carefully controlled laboratory experiments conducted in 1890 to ascertain the relative merits of lanoline and vaseline as a preserving medium may be cited as a good example of the immediate utilitarian researches to which he devoted what time he could spare from his many other duties.

Later when, at his repeated request, the Government of Madras established a central animal vaccine lymph depot for the Presidency, King quickly extended its work to include bacteriological diagnosis and other expert assistance to civil surgeons and medical practitioners, and finally made arrangements for the preparation of prophylactic and curative sera and vaccines and for the prosecution of original protozoological and entomological research of direct importance to tropical medicine. In 1903, when the main buildings of the bacteriological section were completed, the Institute became the provincial laboratory for the Madras Presidency and was named, in recognition of King's services to public health and the efforts he had made to bring it into existence, "The King Institute of Preventive Medicine". In the general scheme for laboratories which had been submitted to the Government of India by the late Surgeon-General Harvey in 1899 it was the third to be established, being preceded only by the Haffkine Institute at Parel, Bombay (1896–99), and the Pasteur Institute of India at Kasauli (1900).

After his retirement, Colonel King served in the War from 1916 as A.D.M.S. Western Command and later was consultant at the Tropical Diseases Clinic, Ministry of Pensions, and lecturer in applied hygiene in the tropics at King's College, London. He had the satisfaction, too, of seeing the institute in India which he founded grow gradually until its activities covered a wider field in the practical application of scientific knowledge to routine medical and public health needs than those of any other laboratory in India.

S. P. J.

PROF. R. CARR BOSANQUET

WE regret to record the death of Prof. R. Carr Bosanquet, formerly professor of classical archæology in the University of Liverpool, which took place on April 21 in a nursing home at Newcastle at the age of sixty-three years.

Robert Carr Bosanquet was the son of Mr. Charles Bertie Pulleine Bosanquet, and was born at Rock Hall, near Alnwick, on June 7, 1871. He was educated at Eton, where he was Newcastle Scholar in 1890 and edited the *Eton College Chronicle*, and at Trinity College, Cambridge, of which foundation he was a scholar. He took firsts in both parts of the Classical Tripos, and was elected to a Craven travelling studentship, which he held from 1895 until 1897.

Bosanquet's interest in archæology was first aroused by the antiquities of Roman Britain which lay within striking distance of his home. In 1897 he excavated Housesteads (Borcovicium) on the Roman Wall. In the following year he was appointed assistant director of the British School of Archæology in Athens, later succeeding to the office of director. In 1906 he was elected to the chair of classical archæology in the University of Liverpool, which he occupied until 1920, when he retired in order to devote himself to the management of the estate which he had inherited from his father, giving such time as this allowed him to further research in the archæology of Roman Britain. He was a member of the Royal Commission on Ancient Monuments in Wales, a position for which his extensive knowledge of Welsh antiquities peculiarly fitted him, and of the advisory board on Ancient Monuments in England.

As an archæologist, Bosanquet had a high reputation among the expert, but neither his achievement nor its qualities was such as to lend itself to building up wide popular recognition. He was one of the group who, following closely in the footsteps of Sir Arthur Evans, at the turn of the century and in the years immediately following placed British archæology in the field in a commanding position in international scholarship, and Bosanquet was one of those who helped to extend that meticulous care in excavation, characteristic of field work in the Mediterranean, to the study of Romano-British sites. As director of the British School at Athens he worked in Crete, where he was responsible for the excavation of the archæologically valuable site of Palækastro, at Phylakopi and in Laconia, where he initiated the important excavation of the temple of Artemis Orthia. He was the author of "Borcovicium" (1904) and part author of "Phylakopi" (1904), but the principal part of his contribution to archæological literature appears in the *Annual* of the British School, the *Journal of Hellenic Studies* and other periodicals. His work was accurate and precise, and informed with wide knowledge. It showed all the polished definition to be expected of a finished scholar.

PROF E. POULSSON

WITH the death on March 19, at the age of seventy-seven years, of Prof E Poulsson, Norway has lost one of her foremost scientific workers. He was chiefly known on account of his work in connexion with the fat-soluble vitamins as they are found in cod liver oil. In innumerable papers he has shown that the female organism in the sexually mature years has a greater vitamin reserve than the male. Similarly, he has proved that the chondropteryginous fishes—in contradistinction to the osseous—are only endowed with negligible quantities of vitamin D, a substance which they manifestly do not require as their framework is only to a very limited extent composed of lime compounds.

Prof. Poulsson was deeply interested in the importance of cod liver vitamins to the growing organism. He showed in several papers the part played by these vitamins in relation to the unborn individual and in habitual abortion, and he did much to extend our knowledge of the medicinal importance of cod liver oil. One of the most important of Prof. Poulsson's contributions to the cause of vitamin research is undoubtedly his well-known method for the quantitative determination of vitamin D. By this method vitamin D was determined in Oslo-units and these were in use in many countries until the international units were introduced. As Norway's representative, Prof. Poulsson was a member of the League of Nations Vitamin Standardisation Committee.

In the sphere of pharmacology Prof. Poulsson was particularly well known. His textbook on this subject is used in many parts of the world in English, Spanish and German translations, and ten editions have been published. The book successfully combines theoretical thoroughness with practical insight. Written in an easy style, it is an invaluable aid for the ordinary practitioner.

Prof. Poulsson was born in 1858. He became a doctor of medicine in 1892, studied chemistry under Fresenius at Wiesbaden and pharmacology under Schmiedeberg at Strasbourg. He was professor of pharmacology at the University of Oslo in 1895–1928. As professor emeritus from 1928 until his death, he was director of the State Vitamin Institute. His charm and directness of manner gained him many friends both at home and abroad.

OTTAR RYGH.

THE death of the eminent American medical historian Lieut.-Colonel Fielding Hudson Garrison at the age of seventy-four years took place on April 18 in the Johns Hopkins Hospital. He was the author of an introduction to the "History of Medicine" (fourth edition, 1929) and numerous articles on the history of medicine, as well as co-editor for some years of the *Index Medicus*, *Quarterly Cumulative Index*, and *Annals of Medical History*, consulting librarian to the New York Academy of Medicine and librarian to the Welch Medical Library at Johns Hopkins University.

WE regret to announce the death on April 9 of Dr. Edouard Antoine Jeanselme at the age of seventy-four years; he was formerly professor of diseases of the skin and syphilis in the Paris faculty of medicine, author of an authoritative work on leprosy (1934) and editor of a treatise on syphilis in several volumes in course of publication.

WE regret to announce the following deaths.

Prof. J E Guthrie, professor of zoology in Iowa State College, on April 16, aged sixty-three years.

Prof. T. C. Hopkins, formerly professor of geology in Syracuse University, known for his work on building stones, clays and iron ores, on April 3, aged seventy-three years.

Prof. George E Johnson, professor of zoology in the Kansas State College, an authority on the physiology of hibernation, on March 18, aged forty-five years.

Prof Wilhelm Kolle, director of the State Institute for Experimental Therapy and of the Georg-Speyer-Haus Chemo-Therapeutical Institute, Frankfurt, on May 10, aged sixty-four years.

Prof J L. R. Morgan, professor of physical chemistry in Columbia University, on April 12, aged sixty-two years.

Prof. E B Skinner, emeritus professor of mathematics in the University of Wisconsin, on April 3, aged seventy-one years.

Dr H. H. Thomas, F.R.S., petrographer to H.M. Geological Survey, on May 12, aged fifty-nine years.

Sir James Walker, F.R.S., emeritus professor of chemistry in the University of Edinburgh, on May 6, aged seventy-two years.

Supplement to NATURE

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Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 834

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Magneto-Optic Rotation

THE subject of the influence of magnetism on light has again been coming into experimental prominence, combined, however, with confusion on the side of theory . and a brief exposition of some considerations which I have treated more privately more than once may be to the public advantage

One may recall that this influence was one of the grand discoveries of Faraday, guided by his own instincts, to be classed as regards mode with the Einsteinian assertion of the relation of gravitation to radiation and its spectrum It was eagerly seized upon by Lord Kelvin, with his engineering instincts, as sheer demonstration that in magnetism there is involved dynamical spin round its axis The electron theory permitted this spin due to magnetisation to be calculated, and conversely and the experiments that have been going on (Barnett, de Haas and Einstein, Sucksmith, and others) have verified the computed result except for a factor which seems to be exactly 2, and demands a more refined theory scarcely yet suitably envisaged

The subject, thus indicated as being at the very foundations of physical science, occupied several chapters, largely speculative, in the second volume of Maxwell's "Electricity and Magnetism" (a book nowhere really much known except in Great Britain and America) which appeared only about sixty years ago, thus being not quite so old as the "Principia". But formulæ thereby suggested, mainly on a vortical basis, for the magneto-optic rotation were passed in review, in relation to such experimental data as then existed, satisfying Verdet's law that the effect was roughly governed as a main factor by the inverse square of the wave-length Afterwards a formula was advanced by the physicist, P Drude, in his "Treatise on Optics", familiar in an American translation , but this appears to be restricted to the very different problem of *natural rotation*, introduced optical dispersion into the result, giving the optical rotation R in terms of the wave length λ by a formula, containing a term for each spectral band λ_r in the form

$$R = \Sigma \frac{A_r}{\lambda^2 - \lambda_r^2},$$

in fact, of the same type as the formula for refraction, $\mu^2 - 1$, in a gas

About 1897 by a happy chance an expression was hit upon for the magnetic case by Henri Becquerel, the discoverer of radioactivity (with whom I was acquainted mainly through Lord Kelvin), which made R equal to the very simple form $e/2mC\ \lambda\, d\mu/d\lambda$, where e is the electron charge and C the velocity of light This has been abundantly tested and comes right except for a factor which (according to Prof C G Darwin) is usually about 3/5 Thus, generally R is as the gradient of μ To obtain a formula, for a gas

$$\mu^2 - 1 = \Sigma \frac{B_r}{\lambda^2 - \lambda_r^2},$$

giving

$$\mu R = \frac{e}{2mC} \frac{-2B_r\lambda^2}{(\lambda^2 - \lambda^2)^2}$$

close to each absorption band where λ is nearly equal to λ_r This of course makes R great, but of the same sign on both sides of the band (in agreement with observations by Macaluso and Corbino at Palermo), whereas the formula of Drude makes the natural rotation of different signs, a result capable of test I remember this contrast, because a hasty assertion by slip of pen to the contrary in "Aether and Matter" (p 353) was soon challenged by my friend Prof R W Wood, of Baltimore, who was experimenting on the subject, to whom therefore might be said to belong the actual type of inappropriateness of the Drude formula This happens to be of peculiar interest in connexion with the remarks in this and more general regards, on R W Wood's "Physical Optics", made in NATURE of March 2, p 325, which suggested the present note as a useful antidote

The Becquerel magnetic formula as above may be written

$$\mu R = \frac{e}{mC} \Sigma \left\{ - \frac{B_r}{\lambda^2 - \lambda_r^2} - \frac{B_r\lambda_r^2}{(\lambda^2 - \lambda_r^2)^2} \right\},$$

the ratio of the second term to the first being $\lambda_r^2/(\lambda^2 - \lambda_r^2)$ thus if λ_r is very small compared with λ the first term, of Drude type, suffices, so that R_r could be regarded as due to one abnormally potent band of absorption in the remote ultra-violet, whereas near the band it is the other term that prevails

The coefficient in this Becquerel formula applies for a gas For a dense substance the Lorentz expression $3(\mu^2 - 1)/(\mu^2 + 2)$ must take the place of $(\mu^2 - 1)$ on the left, and differentiation gives a different factor in R which would make a very considerable difference near the band of absorption.

The necessary references, those available here remote from a library, are *Trans Camb Phil. Soc*, Stokes Commemoration Vol (1900) § 7, as reprinted in the writer's "Collected Papers", vol 2, p 179, which gives a reference to a comparison with records of experiments drawn up by Prof C G Darwin, *Proc Roy Soc.* (1927) : and also my 'Aether and Matter' (1900), p 353, where §§133–8 connect the trend of rotation with that of K or μ^2

A suggestion of more constructive character is led up to by the assertion of the 'obsoleteness of damping' for the discussion of refractive dispersion and absorption. It is not difficult formally to include a frictional term in the Maxwell-Sellmeier formula for dispersion : if one remembers aright, Maxwell had done so. In his book "Magneto-Optik", the eminent Göttingen physicist Woldemar Voigt had doubtless included both magnetic and frictional terms in his scheme of equations, though in a way that would now be regarded as scarcely more than illustrative His resulting triple division of the absorption line, in fact the inverse form of the simplest type of Zeeman effect, would thus be influenced as regards positions and intensities by the damping which need not be negligible for transmission through dense media Hitherto it appears to have been position and polarisation of the components that have been mainly treated But now astronomers have in their hands delicate instruments that can trace the intensity of impression across the broadened line on the photograph with precision If they can provide data from the Zeeman broadening, this would appear to go some way towards doubling the material with which specialists have to deal in this intricate but promising domain

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March 4

Concentration of Artificially Produced Radioelements by an Electric Field

ONE of the best methods of collecting radioelements free from any inactive material is the application of an electric field, either to the gaseous or liquid phase Well-known examples of the former process are the collection of the 'active deposits' produced by the three emanations , of the latter, the electrolytic deposition of these and other isotopes of lead, bismuth and polonium It seemed worth while to investigate whether an electric field might also be of help in concentrating the newly discovered artificial radioelements. Especially interesting is the question as to their possible charge when produced in gases by fast and slow neutrons

In our experiments the neutrons were obtained from 30 millicuries of radiothorium mixed with powdered beryllium, and slowed down by water The field was applied by using a silver flask with an inner electrode, usually in the form of a platinum wire. Each experiment was performed with this electrode charged to $+1300$ volts and 1300 volts alternately (about 300 volt/cm). For various reasons, arsenic seemed one of the most suitable elements and consequently most of the experiments have been done with arsine. As is well known, this compound tends to react on the walls, leaving a deposit of arsenic, but by purifying the gas carefully we were able to suppress its spontaneous decomposition almost completely. As Fermi and his co-workers have shown[1], slow neutrons produce the change $As^{75}+n^{1}\rightarrow As^{76}$, the latter losing its activity with a half-value period of one day.

Without a field no activity whatever was found on the wire, even when this had acquired a visible coating of arsenic. Application of the field, however, in either direction, resulted in the collection on the electrode of up to 30 per cent of the total activity produced by the neutrons, together with only about 0·02 per cent of the total inactive arsenic, the concentration factor (that is, the change in the ratio As^{76}/As^{75}) being in this case 1,500

From these experiments it appears that any characteristic charge which may be imparted to the active arsenic isotope at the moment of its formation is not retained ; it is probable that solid arsenic particles are formed[2], which acquire a charge by catching the ions present in the gas The failure of Fermi and his co-workers to obtain an appreciable improvement in the yield by applying a field to the vapour of methyl and ethyl iodide[3] was probably due to the high vapour pressure of iodine, or to exchange processes We varied the experimental conditions in different ways by changing the pressure of the arsine and the metal of the electrode, by adding hydrogen or water vapour, and by increasing the ionisation by an additional radiation Even when by these variations the chemical decomposition was so much accelerated as to cause the deposition of a layer of arsenic on the electrode of a thickness of about 10^{-4} cm , the yield of the active isotope was only very slightly increased On the other hand, we were able to collect up to 20 per cent of the active isotope on either electrode without any visible layer of arsenic. In such experiments the concentration factor was certainly greater than 20,000.

We think that this method of concentration by an electric field will be of practical use whenever very thin layers of the new radioelements are required There is no reason why it should not be applied to the collection of the non-isotopic radioactive atoms produced by fast neutrons. Here, in the distribution of the charges, a recoil effect will possibly be found The method will also be extended to liquid systems, to which preliminary experiments, in which Dr E Gluckauf has assisted us, have shown it to be applicable

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[1] *Fermi, Amaldi, D'Agostino, Rasetti and Segrè, Proc Roy Soc* , A, 146, 483 , 1934

[2] cf Szilard and Chalmers, NATURE, 134, 462 , 1934

[3] *Ricerca Scientifica*, 5 , December, 1934

Nature of Cosmic Rays

IT seems quite certain that it is not possible to explain all the effects of cosmic rays by means of a single corpuscular component. On the other hand, the results of the direct measurements of the energy of the rays, by their curvature in a magnetic field, are difficult to reconcile with the existence of any simple relation between their energy and penetrating power I want, therefore, to suggest a dualistic theory of the cosmic rays, based on the existence of two primary components, both of great energy, but which are absorbed very differently by matter[1].

The primary corpuscular rays, on arrival at the top of the atmosphere, are supposed to be formed of a mixture of electrons (perhaps of both signs) and of heavy particles, such as protons. These particles, which we may call the *M* and the *D* groups, have energies of the same order, which at a latitude of 45°, lie between 4×10^{9} and 10^{11} electron volts. There must be a large number of particles of group *M* to one of group *D* In traversing the atmosphere, they suffer both a slow loss of energy and also large collision losses due to the formation of secondary electrons and photons The coefficients of absorption for the electrons are about 5×10^{-3} cm ^{2}/gm and for the protons $0{\cdot}7 \times 10^{-3}$ cm ^{2}/gm In light elements, the absorption of both components is nearly proportional to the density of the absorbing material The greater the absorbing material traversed, the stronger is the component *D* relative to *M*, until, under 20 metres of water below the top of the atmosphere, *M* has nearly disappeared[2] In dense matter of low atomic weight (water, earth, etc), the formation of secondaries (electrons and photons) at close intervals determines the creation of multiple rays capable of producing coincidences in counters placed out of line.

If the two groups of rays traverse heavy elements such as lead, they behave quite differently The absorption of the *D* particles is proportional to the mass of matter traversed, and is accompanied by the formation of secondaries and perhaps of showers, as in light elements The *M* particles, on the other hand, suffer very intense absorption due to the emission of radiation during nuclear collisions The photons produced have a short path in lead and give rise to numerous electron-positron pairs This is the origin of the typical shower, such as determines the typical maximum of Rossi's curve.

The concentrated type of shower can be attributed to the occurrence of an absorption process in the interior of a piece of heavy material, and the diffused shower to an absorption process occurring near a free surface, so that the ejected photons spread out and are then absorbed by surrounding dense objects After the decrease which follows the maximum of the curve of showers, that is after 6 cm of lead, only component *D* remains, and the remaining multiple coincidences are to be attributed to secondary effects of this component, with possibly a few showers Rossi's curve is really due to the superposition of the multiple secondary effects of *M* and of *D* If one works at a place where *M* has disappeared, no typical maximum is found, but only the effect of *D*

The absorption of the two groups of particles can be studied by the interposition of screens between the counters as arranged vertically for counting coincidences. The curves so obtained for lead show an initial rapid decrease due to the absorption of the secondary rays, and of group *M*, and then after 10 cm. a slow decrease due to *D*. With matter of lower atomic weight, such as copper, one obtains different curves, in which the rapid decrease due to the absorption of the secondaries is followed by that of group *M*, and after 20 cm by the slow decrease due to *D*

Actually the collision absorption, which increases with the atomic number of the atoms forming the screen, is much smaller in copper, corresponding to the smaller production of showers One can show by absorption in lead that after traversing 8 cm. of copper, there still remains a considerable part of *M* ; the rapid decrease which additional lead then produces is the same as that at the start of the absorption curve in lead. After *M* has disappeared, the component *D* continues alone, with the same mass absorption coefficient in all materials.

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[1] P Auger, *C.R.*, **200**, 739, 1935.
[2] P. Auger, A. Rosenberg and F. Bertein, *C.R.*, **200**, 1027 : 1935

Cosmic Rays and Novæ

IN dealing with this subject in a recent letter[1], I most unfortunately overlooked some recent work of W. Baade and F Zwicky[2] These authors have advanced the highly interesting theory that cosmic rays have their origin in outbursts of *super*-novæ in extra-galactic nebulæ, and did so a year before the appearance of Nova Herculis prompted a search for a possible connexion between cosmic rays and nova phenomena in general Super novæ are thought to occur in each nebula about once in a thousand years, and, from certain hypotheses about what happens during an outburst, Baade and Zwicky show that they probably release energy sufficient to maintain the supply of cosmic radiation as observed at the earth.

I should emphasise that in my own note I offered no theory of the origin of cosmic rays, but sought merely to answer the question : Can ordinary nova outbursts in our own galaxy supply energy sufficient to give the observed intensity of cosmic radiation ? I expected a negative answer. The method I followed in estimating the energy is due to Milne, and is independent of any hypothesis as to what happens actually during a nova outburst It turned out in point of fact that, on the present knowledge of stellar structure, one cannot definitely exclude the possibility of this source of the radiation, *on energy considerations alone*

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[1] NATURE, **135**, 371, March 9, 1935.
[2] *Proc Nat Acad of Sci*, **20**, 254, 259, 1934 *Phys Rev*, **45**, 138, **46**, 76, 1934

The 'Lipotropic' Effect of Protein

EVIDENCE that proteins or substances closely associated with proteins exert a 'lipotropic'* effect has been reported previously from these departments[1,2] In the latter paper it was shown that when rats with fatty livers were placed on a choline-free diet consisting exclusively of sucrose, an increase of some 8 per cent of liver 'fat' was observed to take place within six days In a comparable experiment in which the ration contained 20 per cent protein as 'fat-free and vitamin-free casein' and 80 per cent sucrose, no increase in liver fat was observed at the end of six days It was also shown that 5 mgm of choline exerted a very definite effect on the liver fat of animals receiving a diet low in choline and containing 20 per cent fat. This effect may be regarded as much greater than that of the casein, and the results of more recent experiments indicate that as little as 1 mgm. of choline daily exerts at least as great a 'lipotropic' effect as 2 gm. of the alcohol and ether washed casein which we have used.

In several series of hitherto unpublished experiments in which large groups of animals were used, extensive deposition of liver fat has been obtained consistently with diets low in 'lipotropic' factors but containing 15–21 per cent protein and 3–40 per cent fat. In a series of fifty animals in which a diet low in choline, but containing approximately 40 per cent fat and 21 per cent protein was provided, the average fat content at the end of three weeks was approximately 17 per cent. This figure may be contrasted with that reported recently by Channon and Wilkinson[3]—12·5 per cent for one series of six animals which received 40 per cent fat and 5 per cent protein, and 8·9 per cent for another which received the fat and no protein. The 'lipotropic' effect of protein *per se* is not apparent from the comparison of these results from the two laboratories. The simplest explanation is that the diet used by Channon and Wilkinson contained more non-protein 'lipotropic' factor than the one which we employed.

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* The term 'lipotropic' is used to describe substances which decrease the rate of deposition and accelerate the rate of removal of liver fat.

The results in Table I show that in nine of the ten rats in a group receiving 15 per cent protein and only 20 per cent fat, excessive amounts of fat accumulated in the liver within fourteen days. The deposition is as extensive as Channon and Wilkinson secured with double the amount of fat and one third the amount of protein in the diet. The average gain in weight in the two groups of animals was of the same order.

Table I. Duration of Experiment, 14 Days

Rat No.	Initial Wt.	Final Wt.	Cal. per day	Total Fatty Acids of Liver	* Diet
	gm.	gm.		per cent	per cent
1	166	172	60	18·6	Casein 11·5
2	146	154	51	9·1	Dried egg white 3·5
3	168	180	56	4·4	'Crisco' 20·0
4	140	144	41	11·6	Sucrose 58·3
5	146	136	46	18·5	Salt mixture 4·8
6	154	168	52	12·9	Agar 1·9
7	156	170	47	10·4	Vitamins A and D concentrate
8	176	184	58	14·3	
9	156	154	56	15·7	Vitamin B_1 concentrate
10	150	152	41	20·2	Choline content 1·25 mgm./100 gm.
Av.	155·8	161·4	51	13·6	

* Average daily food consumption was 10·7 gm. containing 0·134 mgm. choline.

In another section of their paper these authors state that the addition of 5 per cent protein prevents the deposition of fat which we noted when a diet composed exclusively of sucrose was used. The figures to support this conclusion are not given, unless the authors refer to their diet (*G*) which contained approximately 5 per cent of 'Marmite'. The protein and sucrose diet containing this material is stated to have provided 2 mgm. of choline per rat daily. We would consider this a substantial amount of choline, and quite sufficient to exert an appreciable effect under the conditions of their experiments. The possibility also exists that 'lipotropic' factors other than choline are present in the 'Marmite' preparation.

We would like to suggest that Channon and Wilkinson have emphasised unduly the effect of slight or moderate undernutrition on the deposition of liver fat. They used a diet containing 40 per cent fat and 5 per cent protein, which resulted in an average content of 12·5 per cent liver fat at the end of three weeks. The average gain in weight of the six animals used was 4 gm. It may be pointed out that equally satisfactory increases in weight with diets quite as effective in producing deposition of liver fat have been reported previously. For example, in an experiment in which the effect of betaine was being studied, two groups of animals—19 and 20 rats—showed an average increase in weight of 5 gm. and 7 gm. at the end of three weeks[4]. Furthermore, Best, Channon and Ridout[5] reported two series of rats in which the average gain was 5·7 gm. and 6·9 gm. in twenty three days. In our experience, slight loss or gain in weight does not exert an appreciable effect on the deposition or disappearance of liver fat, or on the action of choline or other 'lipotropic' substances. This conclusion is well supported by the results in Table II. Twenty rats gained in weight, twelve lost weight slightly, while eight lost a considerable amount. The livers were consistently fatty. We do not believe, therefore, that Channon and Wilkinson were justified in disregarding the results of their experiment in which no protein was provided, and in which the average loss of weight was 19 gm. in three weeks. The average liver fat content was approximately 9 per cent. There would appear to be little, if any, significant difference in the average liver fat obtained in this experiment and in those in which 5 or 10 per cent protein was provided. The fact that the deposition of liver fat is not greater could be attributed, in our opinion, to 'lipotropic' factors contained in the 'Marmite'.

Table II. Duration of Experiment, 21 Days

No. of Rats	Average Change in Weight	Total Fatty Acids of Liver	Diet
	gm.	per cent	per cent
20*	+ 5·4	19·2	Casein 17·8 } Total protein, 21·1 per cent Dried egg white 3·3 } Sucrose 35·0 Beef fat 39·3 Salt mixture 4·6 Vitamin A and D concentrate Vitamin B_1 concentrate
12†	− 2·6	18·4	
8†	− 24·9	19·9	

* All rats gained weight.
† All rats lost weight.

The 'lipotropic' effect of protein should not be underestimated, but in our experience it could be accounted for if the protein contained two or three parts of choline, betaine, or other substances with similar action per 1,000 parts of protein. As we have emphasised previously, protein may exert its 'lipotropic' effect by providing betaine from the metabolism of amino acids, but it is obviously essential to use highly purified proteins or amino acids in investigating this possibility.

We regret that our more recent findings, which appear to us to change, in some degree, the interpretation of their results, were not available to Prof. Channon and Mr. Wilkinson before the publication of their paper. In the circumstances, however, we feel that confusion in the literature will be avoided by the report of these results.

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[1] C. H. Best, *Lancet*, **226**, 1274; 1934.
[2] C. H. Best and M. E. Huntsman, *J. Physiol.*, **83**, 255; 1935.
[3] H. J. Channon and H. Wilkinson, *Biochem. J.*, **29**, 350; 1935.
[4] C. H. Best, **226**, 1274; 1934.
[5] C. H. Best, H. J. Channon and J. H. Ridout, *J. Physiol.*, 81, 409; 1934.

Physiology of Whales

SIR LEONARD HILL[1] suggests that whales' blood should not become supersaturated with nitrogen since there is not enough air in the lungs I have observed that Blue and Fin whales spend the vast majority of their lives submerged—at what depth we may never know—and that their sojourns at the surface are usually momentary The result is that while the decompressed state of the whale lasts only for a few seconds in every ten to twenty minutes, the compressed state predominates Therefore there is a constant passage of nitrogen into the blood and very little opportunity for it to return into the lungs Supersaturation is bound to occur if the whale's dive is sufficiently deep

May I be allowed to advance an *a posteriori* reason for believing that the whale dives deep enough to produce supersaturation of the blood with nitrogen? It lies in the phenomenon of nitrogen removal which occurs in whale blood and to which I have already directed attention[2] The blood of Blue and Fin whales is capable of so absorbing atmospheric nitrogen that it is not to be regained by evacuation of the blood[3] It is a most interesting fact that one of the few mammals which might run the risk of caisson sickness is just the one to have a mechanism for avoiding it

Prof Krogh has objected[4] that the rate of nitrogen removal shown in my experiments is too low to clear the blood of excess nitrogen quickly enough The scope of my experiments sufficed only to establish the fact of nitrogen removal and not the rate, which may easily prove to be higher in the blood of living whales or when estimated by a more efficient technique than I was able to use

In this connexion, I originally suggested that bacteria in the blood were the cause of the nitrogen removal Further work on whale blood at the London School of Hygiene and Tropical Medicine has failed to support this. The nature of the reaction is not known, except that oxygen is apparently required.

With reference to Dr Argyll Campbell's suggestion[5] that whales avoid caisson sickness by filling their lungs with water before a dive, I think it may safely be said that this is unlikely since the blast of exhalation is composed only of gases and water vapour I have just returned from a whale-marking cruise, during which I frequently passed through the column of vapour left by a whale On one occasion while I was standing in the bows of the whaler, a large Blue whale, about ninety feet long, came up directly beneath the bows and blew in my face. The blast was tremendous and seemed curiously cold, little warmer than the surrounding atmosphere, 5°–6° C This chilliness is, I imagine, a result of the decompression of air in the whale's lungs When the whale dives, the air is compressed and produces heat, which is absorbed gradually by the tissues of the lung During the ascent to the surface the air expands and absorbs heat. The air in its chilly state is discharged before it has time to absorb heat from the lungs and, being saturated with water vapour, appears as a thin mist. This explains why the blast of whales is visible in the tropics where the breath of other mammals is invisible. But only the blasts from whales which have come up from a deep dive will be visible. No decompression cooling will occur in the lungs of whales which did not dive deep and come up again fairly rapidly.

Dr J S Haldane tells me that the same phenomenon occurs in the air lock of caissons, where on decompression the air becomes very cold and supersaturated with moisture Difficulty is experienced in getting the workers to stay long enough in the lock on account of the chilly discomfort.

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[1] Hill, L, NATURE, **135**, 657, April 27, 1935

[2] Laurie, A H, NATURE, **132**, 135, July 22, 1933

[3] Laurie, A H, "Some Aspects of Respiration in Blue and Fin Whales", *Discovery Reports*, **7**, 363–406, 1933

[4] Krogh, A, "Physiology of the Blue Whale", NATURE, **133**, 635, 1934

[5] Campbell, J Argyll, NATURE, **134**, 629, Oct 20, 1934

Osmotic Pressure of Fixing Solutions

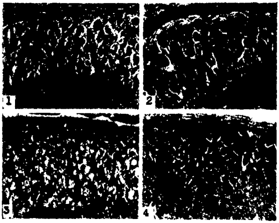
IT has long been the custom in many laboratories to make up certain fixatives in saline solutions, but the value of this practice has recently been questioned[1] on the ground that the osmotic pressure of most fixatives, as determined by the freezing point, is already greater than that of the tissues. However, since the particles of the fixative are presumably able to pass more or less freely across the surface membranes of the cells, it seems likely that they do not produce any effective osmotic pressure If this is so, then the freezing point of a fixing solution is no guide to its 'physiological' osmotic pressure. Further, it is possible that the addition of salts to fixatives is necessary to prevent the distortion which would result from the fact that the particles of fixative differ from those of the tissue fluids in mobility and electrostatic charge

Since very few critical data exist about the effects produced by fixatives made up in salt solutions[2], it was decided to test the question carefully, using a marine invertebrate in which osmotic effects should be especially conspicuous on account of the high internal concentration of salts A number of fixatives, both single substances and fixing mixtures, were made up in distilled water and in sea-water, and were then tested as to their effects on the stellate ganglia of *Sepia officinalis*, in which the saline concentration of the blood is close to that of sea water Each ganglion was cut into two pieces, one of which was fixed in the solution in sea-water, the other in that made up in distilled water After fixation, the two pieces were transferred to a single receptacle and treated together in all subsequent processes, embedded side by side in paraffin and sectioned in the same block.

It was found that the presence of salts in the fixative is *essential* for good fixation, especially with fixatives which penetrate slowly[3] such as those composed of potassium bichromate, formaldehyde, chromic acid, picric acid or osmium tetroxide. For example, ganglia fixed in 1 per cent chromic acid or 4 per cent formaldehyde in distilled water showed very great distortion, due apparently to swelling and bursting of the cells (Figs. 1 and 2) Similarly, when such fixatives as Champy, Regaud or Flemming without acetic acid were made up in distilled water, they were found to cause bursting of the cells, especially at the centre of the piece, such effects being absent when the same solutions were made up in sea water (Figs. 3 and 4)

With solutions containing mercuric chloride or acetic acid, the difference between the results obtained with solutions made up in distilled and sea water was less marked, being least of all with Bouin's fluid and 'corrosive acetic', though even with these, some distortion could be detected when the fixative was made up in distilled water

Those results confirm the theoretical anticipation that the particles of the fixative do not exert a fully effective osmotic pressure relative to the tissues One may conjecture that as soon as a piece of tissue is placed in a fixative made up in distilled water, ions begin to diffuse out from the intercellular fluids Therefore, until the more slowly moving particles of fixative arrive, the cells are effectively in a hypotonic medium, and hence swell and burst Fixing mixtures generally contain fast-moving ions the value of which is probably that they counteract this effect However, in many cases the same result can be better achieved simply by the addition of salts For example, 1 per cent chromic acid in sea water is a really excellent fixative for the nerve cells of *Sepia*



Nerve cells of *Sepia* in different fixing solutions. (1) 4 per cent formaldehyde in distilled water, (2) the same in sea water (3) Champy's solution in distilled water, (4) the same in sea water

When dealing with a marine animal, therefore, all fixatives should be made up in salt solutions similar to those found in the blood of the animal, especially if the fixative is based on formaldehyde, chromic acid, picric acid, potassium dichromate or osmium tetroxide. Further work is now being done to determine to what extent similar considerations apply to the fixation of the tissues of land animals

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[1] Baker, "Cytological Technique" London, 1933

[2] Carleton, *Quart J Micr. Sci.*, **66**, 501, 1922 Hirsch and Jacobs, *Z Zellforsch. u. mikr. Anat*, **3**, 198, 1926 Hertwig, *Z mikr-anat Forsch.*, **23**, 484; 1931

[3] Underhill, *J Roy Micr. Soc*, **52**, 113, 1932

MR. YOUNG has kindly allowed me to study his slides. There is no doubt that he has proved his point, and that the conclusions that I have drawn about the osmotic pressures of fixatives in my book "Cytological Technique" are erroneous.

JOHN R BAKER

Chinese Influence on Western Alchemy

IN his very able reconstruction of the origin and development of Western alchemy, Prof A. J Hopkins[1] does not discuss the possible influence of Chinese ideas as the seed which may have served to crystallise alchemical philosophy in Alexandria "somewhat after the beginning of the Christian era" He presents the origin of Egyptian alchemy as a perfectly logical and highly successful application of Platonic-Aristotelian philosophy to the apparently miraculous colour changes effected by the Egyptian craftsman in his closely allied arts of dyeing fabrics and colouring metals

Existing data[2] show that alchemical practices were common in China probably several centuries before they appeared in Egypt, and the suggestion has been made that the Western art possibly owes its inspiration to the former It thus becomes a matter of some interest to determine whether such a possibility is compatible with Prof Hopkins's thesis.

Chinese alchemy[3] was concerned primarily with the twin pursuits of immortality and transmutation In each case the goal was to be reached by changing the base, heavy, coarse, gross, material, undesirable, etc (that is, *Yin*), qualities of man or metal into the opposite noble, light, fine, ethereal, spiritual, desirable, etc (that is, *Yang*), attributes The underlying philosophy regarding why and how this could be accomplished was closely linked with Taoism and the search for the *Tao*, but one gains the impression that Taoism was much more inextricably intermingled with efforts towards longevity and immortality of man than with those towards the transmutation of metals Continuous life (that is, with no intervening death and bodily dissolution) involved bringing man into conformity with *Tao* through the conversion of his *Yin* (material, corruptible) nature into the *Yang* (spiritual, incorruptible, *Tao*) Some assumed knowledge of Taoism, therefore, would appear to have been pre-requisite for any hope of success, including at least a working hypothesis regarding the spiritual part of man On the other hand, in the case of the transmutation of metals as a means to mundane riches or position (that is, when not too closely associated with the idea of immortality and the life-prolonging 'elixir'), attention appears to have been centred more closely on the contraries, *Yin* and *Yang*

It is interesting to speculate on the reception in Alexandria which might have been accorded to marvellous tales of immortality and transmutation carried thither along the trade routes from China It seems probable that stories of immortality, of "the drug which prevents death", of the *hsien* or 'immortals' would have been listened to with incredulity. Since the *Tao* was not comprehended in China, in what a garbled and unintelligible form would Taoism have been discussed in Alexandria—if indeed its very abstruseness would not have prevented any such discussion. Furthermore, the Alexandrian had no personal evidence of immortality in the Chinese alchemical sense, and he already possessed several alternative hypotheses regarding the spirit and soul of man. But the fact that the early centuries of Western alchemy are free from the illusion of immortality, whereas this aspect was the earliest and always the most important feature in China, does not necessarily disprove a Chinese influence on the origin of alchemy in Egypt. Accounts of transmutation, however, could have been received with enthusiasm. The two contraries (*Yin* and *Yang*) might have been identified with the opposing Greek 'elements' of *water* and *fire* and hence with the two 'qualities' of *mercury* and *sulphur* No understanding of *Taoism* would have been necessary The fact that transmutation was alleged to have been accomplished by changing lower qualities or natures into higher ones might have been sufficient to arouse interest, particularly in the mind of the Egyptian artisan who was daily confronted in his workshop with curious and striking changes in the appearance (notably colour) of metals under suitable treatment. Consequently, may not the alleged fact of the practical transmutation of the metals in China as related by traders in Alexandria have been the inspiration for that marriage of Greek philosophy and Egyptian craftsmanship which Prof Hopkins believes gave birth to Western alchemy ?

The purpose of this note is to indicate that the apparent completeness of Prof Hopkins's picture does not automatically preclude the possibility that reports of Chinese alchemy may have had some influence on the origin of the Egyptian art Whether such an influence is considered to be 'improbable' or 'probable', present data still appear to indicate that it is 'possible'.

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March 1

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[1] Hopkins, A J, "Alchemy Child of Greek Philosophy", Columbia Univ. Press, New York, 1934, *Isis*, 7, 58–76, 1925

[2] Barnes, W H, *J Chem Ed*, **11**, 655–658, 1934 Davis, T L, *J Chem Ed*, 11, 517–620, 635, 1934 **12**, 1, 51, 1935 Davis, T L and Wu, L C, *Sci Monthly*, **31**, 225–235, 1930 *J Chem Ed*, **9**, 859–862, 1932, *Isis*, **18**, 210–289, 1932 Edkins, J, *Trans China Branch, Roy Asiatic Soc*, Hong Kong, pt 5, 83–89, 1855 Forke, A, *Archiv Gesch Philosophie*, **41**, 115–126, 1932 Johnson, O S, "A Study of Chinese Alchemy", Commercial Press, Shanghai, 1928 Martin, W A P, "The Lore of Cathay", Chap. iii, "Alchemy in China", pp 44–71, Fleming H Revell Co, New York, Chicago, Toronto, 1901. Partington, J R, NATURE, **119**, 11, 1927 **120**, 158, 1927 Read, B E, NATURE, **120**, 877, 1927 Waley, A, *Bull Sch Orient Studies*, **6**, 1–24, 1102–3, 1930–32

The Ratio 136/137 in Atomic Physics

IN an earlier letter[1] I suggested that some (or all) of the determinations of the specific electronic charge, e/m, disagreed with the value deduced from Sir Arthur Eddington's $M/m = 1847{\cdot}6$ theory (namely, $1{\cdot}7703 \times 10^7$ E.M.U.) because they were really measurements of

$$\frac{136}{137}(1{\cdot}770{,}3_1 \pm 0{\cdot}000{,}1_4) \times 10^7 = (1{\cdot}757{,}4 \pm 0{\cdot}000{,}14) \times 10^7 \text{ E.M.U.}$$

Prof. Birge[2] stated that the measurements agreed with my hypothesis even better than I had suggested, and Sir Arthur Eddington[3] suggested that, on theoretical grounds, the ratio would be expected to be very nearly 136/137.

The hypothesis can now be tested with precision. The seven most recent determinations[4] of e/m are :

$$\left\{\begin{array}{lll} 1{\cdot}757{,}9 & \pm 0\ 002{,}5 & \times 10^7 \text{ E.M.U.} \\ 1{\cdot}758{,}7 & \pm 0\ 000{,}9 & \\ 1{\cdot}757 & \pm 0\ 001{,}5 & \\ 1{\cdot}758 & & \\ 1{\cdot}757 & \pm 0{\cdot}001 & \\ 1{\cdot}757{,}0 & \pm 0{\cdot}001{,}0 & \\ 1{\cdot}757{,}9 & \pm 0\ 000{,}3 & \end{array}\right.$$

The unweighted mean of these seven,

$$(1\ 757{,}6_4 \pm 0\ 000{,}2) \times 10^7 \text{ E M U},$$

may be compared with the value given by my hypothesis

$$(1{\cdot}757{,}4 \pm 0{\cdot}000{,}14) \times 10^7 \text{ E M U}$$

Apparently the factor 136/137 is involved because we analyse a system, such as an atom, into 'separate parts' which 'interact' It seems that the effective mass of the less massive portion may have one of two distinct values according to our point of view.

Prof Birge[5] has pointed out that the estimate of the electronic charge deduced from Millikan's experiment ($4\ 768 \times 10^{-10}$ E S U) and the estimate obtained by the crystal-grating X-ray method ($4\ 803 \times 10^{-10}$) are almost in the ratio 136/137 I wish to make a rather similar suggestion

I have formerly[6] given evidence that Sir Arthur Eddington's theoretical deductions $hc/2\pi e^2 = 137$ and $M/m = 1847\ 6$ are true From these (with the help of Faraday's and Rydberg's constants) we can deduce[7] what I believe to be the most reliable estimate of e, namely

$$(4\ 775{,}9 \pm 0{\cdot}000{,}4_3) \times 10^{-10} \text{ E.S U}$$

I would suggest that the crystal-grating X-ray estimate of e is really an estimate of

$$\frac{137}{136}(4\ 775{,}9 \pm 0\ 000{,}4_3) \times 10^{-10} = (4\ 810{,}9 \pm 0\ 000{,}4_3) \times 10^{-10} \text{ E S U.}$$

This value could also be obtained by assuming $hc/2\pi e^2 = 137$, but using $e/m = 1\ 757_4$ in the Rydberg-Bohr equation

The most recent determinations of e by the X-ray method[8,9] give the values $4\ 806 \pm 0\ 003$ and $4{\cdot}805$, which are in reasonably good accord with the $4{\cdot}810{,}_9$ suggested above Ruark[10] finds that certain discrepancies disappear if he uses $e = 4{\cdot}806 \pm 0{\cdot}003$, $e/m = 1\ 757{,}9 \pm 0\ 0003$, $hc/2\pi e^2 = 137\ 04$

If this second hypothesis of mine is correct, it would appear that the discrepancy between the two methods of estimating the electronic charge (or the two methods of estimating the X-ray wave-lengths) is due to the faulty analysis of a 'system' into two 'parts' I do not know where the error occurs. It may be due to our assuming that '*the* mass' contained in each unit cell in a crystal can be deduced by multiplying 'the volume' of the unit cell by the density of the crystal We naïvely contemplate the system as split up into parts.

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March 8

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[1] W N Bond, NATURE, **133**, 327 ; 1934

[2] R T Birge, NATURE, **133**, 648, 1934

[3] A S Eddington, NATURE, **133**, 907, 1934.

[4] C D Shane and F H. Spedding, *Phys Rev*, **47**, 33, 1935.

[5] R T Birge, *loc cit*

[6] W N Bond, *Proc Phys Soc*, **44**, 374, 1932.

[7] R T Birge, *Phys Rev*, **40**, 319, 1932. (Prof Birge amended my calculation of e, but owing to a numerical mistake he obtained too small a value for the probable error, namely, $\pm 0\ 000{,}048$ in place of $\pm 0\ 000{,}4_3$)

[8] E Bäcklin, NATURE, **135**, 32, Jan 5, 1935.

[9] M. Söderman, NATURE, **135**, 67, Jan 12, 1935

[10] A. E Ruark, *Phys. Rev*, **47**, 316, 1935

Auger Effect and Forbidden Transitions

It is well known that after an atom has been ionised, for example in its K shell, the ensuing reorganisation of the extra-nuclear electronic structure is not by any means invariably accompanied by the emission of K-radiation Quite frequently we have instead a 'radiationless' change of the type first completely specified by Rosseland, which results in the expulsion of a 'photo-electron of the second kind' and in leaving the atom doubly ionised—until further reorganisation occurs—in its X-ray levels These photo-electrons of the second kind were observed by M. de Broglie, but the manner in which they originate was first clearly established by Auger's beautiful work with the Wilson cloud chamber, and it is convenient and not inappropriate to refer to them as Auger electrons

In a recent very interesting paper[1], Mr E H S Burhop has calculated, by the methods of quantum mechanics, the relative probabilities of emission of different types of Auger electrons—that is, corresponding to different types of radiationless switches—from atoms initially ionised in the K shell The Auger electrons resulting from interactions between the L shells fall into six sets, which may be classified thus

(a) $L_I, L_I \to K, \infty$ (d) $L_{II}, L_{II} \to K, \infty$
(b) $L_I, L_{II}, \to K, \infty$ (e) $L_{II}, L_{III} \to K, \infty$
(c) $L_I, L_{III} \to K, \infty$ (f) $L_{III}, L_{III} \to K, \infty$,

the first two symbols indicating the electrons taking part in the disturbance, and the last two their immediate destinations—∞ being an obviously convenient symbol for 'outside the atom'

Of the six sets, those in (a) will have the lowest energy, (b) and (c) will have approximately equal energies, appreciably greater than (a), and a similar thing is true of the fastest sets, (d), (e) and (f) An instrument of moderate resolving power would therefore (at least for light and moderately light atoms) record these six sets of Auger electrons as three groups, namely, I, set (a); II, sets (b) and (c); III, sets (d), (e) and (f) According to Burhop's calculations for element 47 (silver), the relative numbers of electrons in these three groups should be approximately in the proportion 1 . 3 4 . 6 7.

Electrons of Groups II and III were in fact recorded, with about the right relative intensities, by Robinson and Cassie[2] in a paper published in 1926 and quoted by Burhop. The less intense Group I was not observed in the 1926 experiments, but as its appearance—or non-appearance—is a matter of rather special interest, I wish now to point out that it was recorded in some later experiments of Robinson and Young[3], which have been overlooked by Mr Burhop

The special interest attached to this particular group lies in the fact that $L_I \to K$ is a forbidden transition in the X-ray spectral series scheme ($\Delta l = 0$, in the nl_j notation for levels) Its appearance in our experiments and in the β-ray spectra of Ellis establishes experimentally a fundamental difference between the elementary processes which constitute the Auger effect, and the only alternative set of processes which could be invoked to explain the occurrence of photo-electrons of the second kind, namely, the production and internal absorption of the characteristic X-radiation of the atom.

In our experiments of 1930, the Auger electrons of Group I were not very clearly photographed. Since then, in the course of work on a different problem, and using an improved photographic technique, I have occasionally obtained very much better records of Auger electrons. One particularly good example may be quoted here, as it has not previously been published The element under examination was copper (29); the velocities of the electrons are deduced from deflections in a magnetic field, and expressed[4] in terms of (rH) gauss cm. These are converted into equivalent frequencies (ν/R in Rydberg units) by the use of known constants, and hence by comparison with X-ray data the level of origin of the electron can be deduced with certainty

Relative Intensity	rH	ν/R	Type of Electron
1	$277\ 4_6$	405 9	Group I
5	$280\ 4_5$	506 7	Group II
8	$283\ 7_7$	518 8	Group III

The agreement with the theory is striking I think I should add that my own sense of satisfaction with the results is if anything enhanced by the feeling that it may be slightly unmerited, the approximations made in the quantum mechanical theory and—not less—the necessary latitude in my estimates of relative intensities, might well account for differences between experiment and theory appreciably greater than those recorded above The general nature of the experimental results, however, leaves no room for reasonable doubt of the essential accuracy of the quantum mechanical methods which have been applied to the problem

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[1] Burhop, E H S, *Proc Roy Soc*, A, **148**, 272, February 1935
[2] Robinson and Cassie, *Proc Roy Soc*, A, **113**, 282, 1926
[3] Robinson and Young, *Proc Roy Soc*, A **128**, 92, 1930
[4] cf Robinson and Cassie or Robinson and Young, *loc cit*

Supra-conducting Alloys

The behaviour of supra-conducting alloys has been found[1] to be different from that of pure metals in two ways.

(1) The magnetic induction (B) in alloys does not change to zero when they become supra-conducting

(2) A supra conducting alloy shows no discontinuity in the specific heat of such an order as would be expected according to Rutgers' formula[2]

These phenomena seem to be well established, as more recent experiments by de Haas and Casimir[3] and Tarr and Wilhelm[4] are in agreement with (1), while Shubnikow and Chotkewitsch[5] succeeded quite recently in confirming our result (2).

We measured the permeability of the same alloy the specific heat of which we determined and found that magnetic flux could penetrate it at much lower fields than the threshold values of supra-conductivity (compare ref 3). That means that the condition $B = 0$ on which Gorter's[6] thermodynamical treatment is based is not entirely fulfilled in supra conducting alloys and therefore Rutgers' formula must not be applied. In order to investigate the supra-conducting region where $B \neq 0$ (shaded, Fig 1), we determined the change of induction which corresponds to a small change ΔH in the external field between T_1 and T_2 in rods of $Pb_{30\%}\ Bi_{70\%}$ Curve 1 is the threshold curve from a very similar alloy[7], while curve 2 indicates the field strengths at which flux first penetrated the alloy.

(*a*) When the specimens were cooled previously in zero field, no change of induction was observed below curve 2 After passing curve 2, flux entered the alloy when switching on $\triangle H$ but no flux left when switching off. This continued until near curve 1 the changes became reversible and finally normal after passing curve 1

(*b*) On cooling to T_1 in H_1, no changes were observed below the reversible region near curve 1 for switching on or off $\triangle H$

(*c*) Warming up again to T_1 gave the same result as in (*b*)

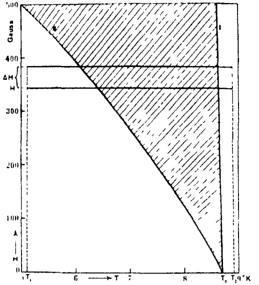

FIG 1

A possible explanation for all these phenomena is that the threshold value is high in some parts of the alloy while the main part has about the same value as pure metals Such a model would act like a fine supra conducting sponge the meshes of which are formed by annular regions of high threshold value impenetrable for magnetic flux that has once been caught in them. If the alloy is cooled in an external field, the sponge becomes supra-conducting first and the induction inside the meshes cannot change to zero (1). As the main part of the alloy has a low threshold value, this will cause only a very small discontinuity in the specific heat (2). Finally, this explanation conforms with the experiments (*a*) to (*c*). In (*a*), at first there is zero induction inside the meshes and no lines of force can enter the alloy After passing curve 2, some meshes of the sponge break down whenever the field is increased and magnetic flux enters them On switching off $\triangle H$, however, this flux is not pressed out again as the material inside the meshes is no longer supra-conducting in this region of the H, T-diagram. This filling up with magnetic flux continues until near the threshold curve all changes of flux become reversible. In (*b*) and (*c*) the meshes already enclose lines of force in the normal state which are 'frozen' in as soon as the sponge becomes supra-conducting (1), and from now on no flux enters or leaves the sponge until finally curve 1 is reached again.

The question arises whether the skeleton of such a sponge of high threshold value is a supra-conductor of zero induction, or if the meshes are formed by supra-conducting regions the thickness of which is of the order of the penetration depth of currents in supra conductors[8] or even of atomic dimensions, for both of which the description of supra conductivity by zero induction has lost its significance Further, it is not yet clear if such a sponge has the same high threshold value throughout, or if it consists of meshes of all threshold values between curves 1 and 2, so that the supra conducting cross-section gradually increases with decreasing temperature Results similar to those in alloys have been obtained on fairly pure (90–99 per cent) tantalum For tantalum the steepness of curve 1 was found to be about 1,500 gauss/degree while that of curve 2 was 650 gauss/degree

A detailed account of these results will be published elsewhere

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April 3

[1] T C Keeley, K Mendelssohn, J R Moore NATURE, **134** 773 1934
[2] A J Rutgers, *Physica* 1, 1055 1934
[3] W J de Haas and J M Casimir Jonker, NATURE, **135**, 30, Jan 5, 1935
[4] F G A Tarr and J O Wilhelm, *Can J Res*, **12**, 265, 1935
[5] L W Shubnikow and W J Chotkewitsch, *Phys Sow*, **6**, 606, 1935
[6] C J Gorter and H Casimir, *Physica*, **1**, 305, 1934
[7] *Comm Leiden*, 214b
[8] Becker, Heller and Sauter, *Z Phys*, **85**, 772, 1933 H London, NATURE, **133**, 497, 1934

Electrical Resistance of Pure Aluminium at Liquid Helium Temperatures

THE electrical resistance of aluminium at liquid helium temperatures has been investigated by Tuyn and Kamerlingh Onnes[1], by Meissner and Voigt[2], and by Keesom[3], who discovered that this metal becomes supra-conducting at about 1 14° K The measurements of Meissner and Voigt appear to show that the resistance of aluminium in the liquid helium region between 4 2° and 1 3° K is not constant, but increases slightly with decreasing temperature On the other hand, Tuyn and Kamerlingh Onnes, as well as Keesom, have found that the resistance is constant in this region, but examination of their data shows that the residual resistance of their specimens was larger than those of Meissner and Voigt A slight increase of resistance at liquid helium temperatures has also been reported for molybdenum, cobalt and magnesium[3], and recently for gold[4] Since such a phenomenon is of considerable theoretical interest, and since we had at our disposal some samples of very pure aluminium, we have made further measurements on the resistance of this metal at liquid helium temperatures

The aluminium used in our investigation was supplied by the British Aluminium Co., and was specified to be at least 99·995 per cent pure It was drawn in this laboratory into wires of 0·15 mm diameter. Spectrographic analysis of the metal, taken before and after drawing, showed only minute impurities due to magnesium, calcium and perhaps copper Four specimens varying in length from 68 cm. to 86 cm. were selected from the wires, these are hereafter designated as Nos 3, 4, 5 and 6 Specimens 5 and 6 were annealed for 3 hours in high vacuum at 250° C., and No. 4 at 275° C; specimen 3 was not annealed The values of $R_T/R_{0°C}$, calculated from the measured resistance of these wires at the temperatures indicated, are plotted in the accompanying graphs (Fig. 1, see over)

As seen from the graphs, the curves which best fit our values of $R_T/R_{0°C}$ are straight lines parallel to the temperature axis The absolute experimental error in the ratios we estimate as not greater than 0·00002 According to the data of Meissner and Voigt, we should expect an increase in $R_T/R_{0°C}$ of between 0 00007 and 0 00014 in the temperature interval 4 2° to 2 2° K Since Nos 5 and 6 show smaller values of $R_T/R_{0°C}$ in this region than any previously reported for aluminium, we conclude that, within the accuracy of our measurements, there is no increase in the resistance of pure aluminium down to 2 2° K

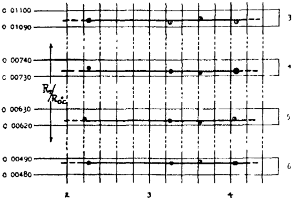

FIG 1 Relation of $R_T/R_{0°C}$ to temperature for aluminium at low temperature

The liquid helium for these experiments was produced by the new helium liquefier designed by Prof P Kapitza[5] A detailed report of these experiments will appear elsewhere

H A BOORSE
H NIEWODNICZAŃSKI

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[1] *Leiden Comm*, No 181, 1926
[2] *Ann Phys*, 7, 761, 1930
[3] *Leiden Comm*, No 224c, 1933
[4] W J de Haas, J de Boer and G J van den Berg, *Physica*, 1, 1115, 1934
[5] *Proc Roy Soc*, A, 147, 189, 1934

Range of Action of Surface Forces

IN a recent letter, Wilsdon, Bonnel and Nottage[1] suggest that anomalies observed in the vapour pressure, osmotic pressure and flow of water in porous materials and in capillaries are due to oriented chains of water molecules extending to a distance of 50 × 10^{-6} cm. from the surface. The possibility of such a structure has been suggested by Hardy[2], and by Watson and Menon[3], who found that a polished plate floated in air or water at a height of 40 × 10^{-6} cm from a parallel plate Further experiments[4], however, carried out at Sir William Hardy's suggestion showed that the separation of the plates was due to dust or to some similar commonplace cause.

More recently, Derjaguin[5], from observations on the resistance offered by water to the movement of an oscillating lens, concluded that a water film 1 × 10^{-5} cm. thick has a rigidity about 1/300 of that of solid lead. We have measured the resistance offered to the flow of thin liquid films enclosed between parallel surfaces. A relatively thick film (60 × 10^{-6} cm) of a 1 per cent solution of ammonium oleate in water (a liquid crystal known to possess a slight bulk rigidity) gave the results shown in Fig 1 (Curve 1), a pressure head of about 2 cm. being required to cause appreciable flow.

A water film, 16 × 10^{-6} cm. thick, gave Curve II, which is linear and passes through the origin Similar results were obtained with alcohol, cyclohexane, acetic acid and ethyl palmitate Experiments with thinner films (*circa* 10^{-5} cm), and with liquids cooled to within 0·1° C. of the freezing point, also gave no evidence of rigidity, since the smallest measurable pressure (< 1 mm. head) always produced a normal flow and within the accuracy of the measurements *the viscosity of the film was the same as that of the liquid in bulk.*

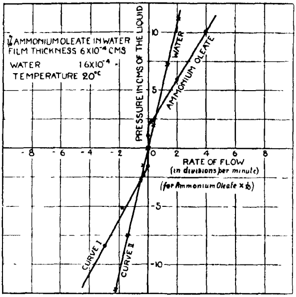

FIG 1 Resistance to flow of thin liquid films between parallel surfaces

The mechanical properties of the first few molecular layers of an adsorbed gas or liquid may be profoundly modified by the solid surface, but no such effects can be detected at distances of 10^{-6} cm and the extension of rigid chains to a distance of 50 × 10⁻ cm. seems quite out of the question.

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[1] Wilsdon, Bonnel and Nottage, NATURE, 135, 186, Feb 2, 193
[2] Hardy, *Phil Trans Roy Soc*, A, 230, 1, 1932.
[3] Watson and Menon, *Proc Roy Soc.*, A, 118, 211 1928
[4] Bastow and Bowden, *Proc. Roy Soc*, A, 134, 404, 1931
[5] Derjaguin, *Z Phys.*, 84, 657, 1933.

Interchange of Heavy Atoms in Organo-Metallic Methyls

USING the radioactive indicator method in which radioactive isotopes are used to indicate transference of atoms, we have obtained evidence which suggests that both lead and bismuth, deposited, presumably as oxides, on a metallic surface, can exchange with lead in lead tetra-methyl and bismuth in $Bi(CH_3)$ in ether solution at room temperature.

For bismuth the radioactive isotopes radium E and thorium C, periods 5 days and 60·5 minutes respectively, were used, and for lead, ThB with period 10·6 hours was employed.

The following experiment is typical. A piece of gold is activated with $Th(B + C + C' + C'')$ by exposure to thoron in the usual way. The gold is immersed in a *solution of $Bi(CH_3)_3$ in ether for two* hours. Then a small quantity of the solution is introduced into a small pot inside a Wilson expansion chamber filled with nitrogen The solution evaporates from the pot, and eventually the $Bi(CH_3)_3$ settles on the boundaries of the chamber, perhaps oxidised by traces of oxygen The characteristic α-tracks of $Th(C' + C'')$ are observed starting from parts of the chamber remote from the pot, thus proving that a volatile compound of ThC has been formed which has evaporated with the rest of the solution The rate of decay of these α-tracks supports the view that the volatile radioactive substance contains ThC and not ThB A similar effect is found if a source of RaE on nickel is inserted in $Bi(CH_3)_3$ solution After a few days the shorter α particles of the subsequent element polonium are found distributed throughout the chamber

It was necessary to test the hypothesis that the above effects are due to the liberation of 'free methyls' by the break up of heavy molecules under α and β ray bombardment Such free methyls might pick up atoms from the metallic surface and thus form the volatile radioactive compounds observed If this mechanism were correct, it must operate for any molecule rich in methyl groups and capable of being broken up. The experiments were therefore repeated, replacing the $Bi(CH_3)_3$ by $N(CH_3)_3$, $Si(CH_3)_4$ and $Sn(CH_3)_4$, but in each case the volatile α activity observed was too small to be distinguished definitely from the normal contamination and was certainly of a different order from the effect with $Bi(CH_3)_3$ and $Pb(CH_3)_4$ This indicates that the exchange process occurs mainly between atoms of the same atomic number and without the break up of the molecule

With $Pb(CH_3)_4$ and $Th(B + C + C' + C'')$ the effect is remarkable in that the unmistakable α emission of $Th(C + C')$ is observed immediately evaporation begins, and photographs showing these α-particles starting in the gas have been obtained This indicates the unexpected presence of a volatile bismuth compound. On the other hand, the rate of decay of the activity in the chamber is consistent with the ten-hour period of ThB, which must therefore have distilled over with the ThC. This may be explained if the oxidation of $Bi(CH_3)_3$ is inhibited or retarded in the $Pb(CH_3)_4$ solution, which will therefore contain equilibrium amounts of $ThC(CH_3)_3$ and $ThB(CH_3)_4$ which will evaporate together

Measurements of the rate of interchange are in progress using an ionisation method and also a tube counter system constructed by Miss E. E. Widdowson, whom we wish to thank, together with Prof. Arthur Ellis, who kindly gave us some old radon tubes.

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Ebulliometric Determination of the Degree of Decomposition of an Organic Substance

IN previous papers it has been shown that the application of an ebulliometer with several dephlegmators[1] (Fig. 1) filled with an azeotropic mixture of benzene and ethanol or any other binary mixture forming with water a ternary azeotrope, enables one to determine with an accuracy up to 0 001 per cent the quantity of moisture in solid organic substances soluble in the above-mentioned azeotrope The same method can be applied for determinations of the degree of decomposition of organic substances forming water as one of the products of decomposition

Let us suppose that the decomposition of succinic acid by heating to the temperature *t* is examined For this purpose a certain quantity of this acid is placed in a test-tube which is afterwards closed like a Carius tube After heating for a certain time at the given temperature, the tube is carefully shaken and the substance is brought to the vessel *A* of the ebulliometer, which is filled with azeotropic mixture of benzene and ethanol The water formed by the decomposition of succinic acid forms a ternary system (azeotropic mixture) with benzene and ethanol, which has a lower boiling point than the mixture of benzene and ethanol Noting the lowering of the condensation temperature in the upper part of the ebulliometer (the thermometer is placed in the uppermost test-tube of the apparatus), it is possible to calculate the quantity of water formed, after carrying out a direct determination of the lowering of temperature per milligram of water, introduced into the ebulliometer The heating of the reflux tubes by microburners must be so regulated that the number of drops flowing through the drop-counters *F*, F_1, F_2, F_3 is approximately the same in both experiments.

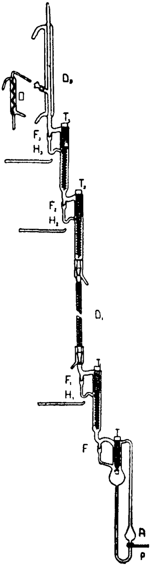

FIG. 1

The method makes it possible to determine the formation of 0·001 per cent of water by the decomposition of substances. Details will be published elsewhere.

W SWIETOSŁAWSKI.

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Polytechnic High School,
Warsaw.

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[1] W. Swietoslawski, *Chemicke Listy*, 26, 772; 1932. *Conferencias de* Introduccion de IX Congresso International de Quimica Pura Y Aplicada, Madrid, 5–11 April, 1934, p 9

Ebulliometric Method of Determining the Amount of a Substance Adsorbed on the Surface of Solid Substances

EBULLIOMETRIC apparatus with a few dephlegmators constructed by W. Swietoslawski, applied to the determination of very small quantities of impurities[1], can be used to investigate the amount of substances adsorbed on the surfaces of solid materials such as glass or metals.

The ebulliometer is filled with a substance which gives an azeotropic mixture with that adsorbed. At the beginning of the measurement, the liquid in the apparatus is allowed to boil, the distribution of temperatures is noted, and afterwards it is cooled down. The adsorbing system is placed in the tube with vapour of the substance to be adsorbed, then cleaned with a stream of dry air, and introduced into the column of the apparatus. After heating up again the liquid in the ebulliometer, its vapour flows to the column and removes the adsorbed substance from the surface of the adsorbent, and forms the azeotropic mixture which rises to the upper section of the apparatus. There a considerable lowering of the temperature of condensation of vapours is observed. Then a known amount of the same substance that was adsorbed is introduced into the apparatus, in order to find the lowering of the temperature of condensation produced by 1 mgm. of the substance under investigation. From the lowering caused by 1 mgm. and that produced by the substance adsorbed it is possible to calculate the amount of the substance adsorbed on 1 sq. cm. of the surface of the investigated materials.

Investigations were carried out with benzene vapour adsorbed on the surface of glass and copper at 18° C. In the ebulliometer there was an azeotropic mixture of ethanol and water. The numerical data obtained for these systems are as follows.

Amount of benzene adsorbed on 1 cm.^{2} at 18° C.

Amount of benzene adsorbed on 1 cm.^{2}

Glass	Copper
0·00019 mgm.	0·00026 mgm.
0·00034 ,,	0·00052 ,,
0·00023 ,,	0·00022 ,,
0·00029 ,,	0·00035 ,,
Average 0·00026 ,,	Average 0·00034 ,,

Details will be published shortly.

M. WOJCIECHOWSKI.

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[1] See the foregoing letter of W. Swietoslawski.

Compressibility of Electrolytic Solutions

THE adiabatic compressibilities of some strong electrolytes have been measured as a function of the molar concentration c by means of a new optical method, which has been developed in the Department of Electrolytic Research of the University of Cologne. It was found that the linear dependence of the apparent molal compressibility on the square root of the concentration is valid (within the experimental error of 0·1 per thousand), also in dilute solutions, even in solutions ten times more dilute than those on which Gucker[1] based his calculations.

The limiting slopes derived from the interionic attraction theory by Gucker agree with our new experimental results only for the 1-1- and 1-2-valent salts, whereas in the case of electrolytes of higher valency a smaller slope was measured than that expected by theory. Different electrolytes of the same valency type show individual characteristics, a fact which Gucker was the first to point out[2].

The compressibility, k, as a function of c is given by the following relation: $k = Ac + Bc^{3/2}$. Gucker supposed that the apparent molal compressibility of non-electrolytes is also governed by the square root law with respect to c. This was not confirmed by our new measurements on cane sugar. We intend to make a further improvement in the experimental method by determining the middle of the nodal lines by a photometric method. It will then be possible to reach the region which is of special interest for the interionic attraction theory. Many other problems will be of great interest: for example, the effect of dielectric constant or temperature upon the compressibility.

A detailed account of the work will be published soon by one of us.

H. FALKENHAGEN.
CH. BACHEM.

Abteilung fur Elektrolytforschung am
Physikalischen Institut der Universität,
Köln.
March 29.

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[1] F. T. Gucker, *J. Amer. Chem. Soc.*, **55**, 2709; 1933. *Chem. Rev.*, **13**, 111; 1933.

[2] The theory by La Mer, Gronwall, Sandved may be able to give an explanation of this behaviour. See Falkenhagen's monograph on "Electrolytes", Clarendon Press, Oxford, 1934.

Mathematical Psychology of War

As NATURE has encouraged scientific workers to think about public affairs, I beg space to remark that equations, describing the onset of the War, and published under the above title* in 1919, have again a topical interest, in connexion with the present regrettable rearmament. In revised form

$$\frac{dx_1}{dt} = k_{12}\, x_2 - \gamma_1 x_1 + \Delta_1\,;$$

$$\frac{dx_2}{dt} = k_{21}\cdot x_1 - \gamma_2\, x_2 + \Delta_2$$

The suffixes 1 and 2 refer to the opposing nations, or groups of nations. The symbol x denotes the variable preparedness for war; t is the time; k is a 'defence-coefficient' and is positive and more or less constant; γ is a 'fatigue and expense' coefficient and is also positive and moderately constant. Lastly, $\angle$ represents those dissatisfactions-with-treaties, which tend to provoke a breach of the peace.

If Δ_1, Δ_2, x_1, x_2 could all have been made zero simultaneously, the equations show that x_1 and x_2 would have remained zero. That ideal condition would have been permanent peace by disarmament-and-satisfaction. The equations further imply that mutual disarmament without satisfaction is not permanent, for if x_1 and x_2 instantaneously vanish, $dx_1/dt = \Delta_1$ and $dx_2/dt = \Delta_2$.

Unilateral disarmament corresponds to putting $x_2 = 0$ at a certain instant. We have at that time:

$$\frac{dx_1}{dt} = -\gamma_1 x_1 + \Delta_1\,,$$

$$\frac{dx_2}{dt} = k_{21}\;x_1 + \Delta_2.$$

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* Obtainable from Geneva Research Center, 2 Place Chateaubriand, Geneva, price 5s. post paid. Few copies remain.

The second of these equations implies that x_2 will not remain zero , later, when x_2 has grown, the term $k_{12}.x_2$ will cause x_1 to grow also So unilateral disarmament is not permanent, as Germany has shown us

A race in armaments, such as was in progress in 1912, occurs when the defence-terms predominate in the second members of the equations We have then approximately

$$\frac{dx_1}{dt} = k_{12}\ x_2, \qquad \frac{dx_2}{dt} = k_{21}\ x_1,$$

and both x_1 and x_2 tend towards infinity.

I submit that the equations do describe, at least crudely, the way in which things have been done in the past As to the future, while indicating the desirability of disarmament-and-satisfaction, they suggest that such a condition might easily become unstable, and that there is a need for controlling terms of a quite novel type More strength to the statesmen who are trying to provide such !

LEWIS F RICHARDSON

38 Main Road,
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April 11

Some Uses of the Air-Driven Spinning Top

SINCE no measurements have so far been published, from any country, on colloidal systems using the air-driven spinning top of Henriot and Huguenard[1], it is evident that the great importance of this remarkable tool has escaped the attention of most laboratories This is especially surprising in view of the fact that any good mechanic can make the necessary simple equipment (a stator and a hollow rotor) for a cost of about two or three pounds, and that for most purposes no special precautions need be taken as to constancy of temperature or control of pressure With much less than the pressure of air available in an ordinary garage, the top may spin at several thousand revolutions per second, producing centrifugal forces of the order of 10^3–10^6 times gravity.

We therefore mention a few of the purposes which since 1931 we have found to be served by the use of this intriguing invention in one of the forms perfected by the originators[1] This is quite apart from the elaborate studies which have proved necessary in the attempt to develop the top as a convectionless transparent ultra-centrifuge, paralleling those of Svedberg These will be reported *on elsewhere*[2] We only remark here that in one case last year an accidental disturbance created a sharp boundary in a sedimenting solution of mercuric chloride, affording a unique opportunity of observing a sedimentation constant S, as measured upon the photographs, equal to $8\ 90 \times 10^{-13}$ as compared with theory $8\ 91 \times 10^{-13}$

Convection does not occur in an immobilised system. Sedimentation may be observed by eye, by callipers, by a scraping pipette, or by pouring off supernatant liquid and weighing. Evaporation is minimised by a solid cover or by a thin piece of cellophane which can be perforated by a hot wire without disturbing the spinning top We find that the best method of preventing interaction between steel tops and their contents is to bake on several thin coats of bakelite lacquer One may take advantage of these factors in the following ways .

(*a*) Measurement of rate of sedimentation of jellies and curds. Examples studied : agar, silicic acid, and sodium palmitate in water , soap jellies in non-aqueous solvents.

(*b*) Purification of gelating colloids. Examples studied . agar, where half of the agar does not sediment with the rest of the agar jelly

(*c*) Measurement of swelling pressure of jellies. When the jelly refuses to sediment further, it is in equilibrium with its swelling pressure

(*d*) Replacement of ultra filtration Supernatant liquid or mother liquor may be removed from a sedimenting system, avoiding all effects of pore-size or adsorption

(*e*) Measurement of bound or combined water in colloidal or biological systems using a reference substance separated as in (*d*) for analysis

(*f*) Bound water, by increasing the density through addition of indifferent substances until sedimentation just ceases to occur Then the reciprocal of the density of the system is identical with the partial specific volume of the non-sedimenting structure The composition corresponding to this partial specific volume may be read from a table or graph of densities against composition The simplest graph to read is that for the jelly itself, as for example agar in pure water

(*g*) Determination of sorption Example methylene blue, which is strongly adsorbed by most materials, using method (*d*)

(*h*) There are many other possibilities, such as the observation of sedimentation equilibrium within any *immobilised system*

We are of the opinion that all chemical, biological, metallographic and applied science laboratories might well employ one or more of these simple devices. Physical laboratories have long recognised the usefulness of solid tops as originally developed[1] for the measurement of the velocity of light, either with a path of only one metre or with the refinements and precision of the last work of Michelson

JAMES W. MCBAIN

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California

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[1] E Henriot and E Huguenard, *J Phys et le Radium*, 8, 433, 1927 *C R*, 180, 1389, 1925

[2] A private communication from Prof J W Beams describes another beautifully simple and elegant means of eliminating the most serious difficulties of ultra-centrifuge design , this will appear shortly in *Science*

A New Test of the Magneto-Ionic Theory

ACCORDING to the magneto-ionic theory of Appleton[1], we should expect a wireless wave incident on the ionosphere to be returned to the earth as two differently polarised components (the ordinary and the extraordinary) with a slight difference in the time of travel For wave-lengths shorter than 214 metres (the critical wave-length of the theory, given by the expression $\lambda = \frac{2\pi mc^2}{He}$), the theory has been experimentally confirmed[2,3] and the following points are well established

(*a*) The two magneto-ionic components are circularly polarised

(*b*) The left-handed (ordinary) component penetrates the F region and the E region more easily than the right-handed (extraordinary)

(*c*) The intensity of the extraordinary wave decreases markedly as the magneto-ionic critical wave-length is approached The theory predicts different results for waves of length greater than 214 metres, but so far as we know, experiments have not been made to test it for these wave-lengths.

To test the theory for the longer wave-lengths the following conditions are necessary·

(*a*) The wave-length must be sufficiently removed from the magneto-ionic critical wave-length, so that the extraordinary wave is not too strongly absorbed This necessitates the use of a wave-length greater than 400 m

(*b*) To investigate the relative penetrating powers of the two magneto-ionic components, it is necessary to work at a time when the ionisation density in one of the ionospheric regions is small enough to permit at least one component to penetrate This occurs only with the *E* region, and then only at midnight in midwinter.

During January and February of this year we have made experiments to compare the behaviour of waves of length greater than 214 m with the well-known behaviour on shorter wave-lengths Pulse transmissions of the Breit and Tuve type were provided from a nearby transmitter and the wave-length could be varied within the range from 400 metres to 500 metres The receiver was equipped with a circularly polarised aerial so that the polarisation of the received echoes could be investigated The values of the equivalent height, the state of polarisation, and the relative intensity of the two component waves were all determined for a series of different wave lengths

The results of the experiments were as follows·

(*a*) For wave lengths greater than 214 metres the right-handed (extraordinary) component penetrates the *E* region more easily than the left handed, so that it may be reflected from the *F* region while the left-handed component is reflected from the *E* region. This is the opposite of what happens on the shorter waves and is in accordance with the theory

(*b*) The fact that the extraordinary component is reflected at all means that in the reflecting regions the quasi-transverse approximation to the magneto-ionic equations must hold, that is,

$$\frac{y_T^4}{4y_L^2} > z^2 + (1 - x)^2,$$

using the nomenclature of reference 1.

(*c*) For wave-lengths which just penetrate the *E* region, the *F* region echo is split, with the extraordinary component uppermost This may be due to differences in the group velocities of the two components in the *E* region or in an intermediate region.

(*d*) On several occasions there was evidence of reflection from an intermediate region at an equivalent height of about 150 km

F T FARMER
J A RATCLIFFE

Cavendish Laboratory,
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March 1.

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[1] Appleton, *J Inst Elec Eng*, 71, 624, 1932

[2] Appleton, *Proc Phys. Soc*, 45, 208, 1933

[3] Ratcliffe and White, *Phil Mag*, 16, 432 1933

Detonation of Nitrogen Iodide, $NI_3.NH_3$

WHEN moist nitrogen iodide is suspended in air over phosphorus pentoxide in a glass vessel and the vessel evacuated by a mercury vapour pump, the crystals detonate as soon as they become dry On the other hand, the substance can be completely decomposed into iodine and permanent gases without detonation occurring if the pressure of the permanent gases be not allowed to fall below 2×10^{-3} cm. At room temperature the decomposition can be completed in 12–24 hours On carrying out the decomposition at −20° C. there is little reaction until the water is removed, after which the pressure rises linearly for a time. As iodine begins to condense out on the walls of the glass vessel, the rate of evolution of gas decreases and ultimately the pressure reaches a constant value, although some nitrogen iodide is still undecomposed After this steady state is reached, on subjecting the residue to a hard vacuum it detonates On detonation, the amount of permanent gas produced is only 30–50 per cent of that liberated during the thermal decomposition

The thermal reaction is retarded by the easily condensible products of decomposition and also by water, and on removal of these substances, nitrogen iodide detonates spontaneously This accounts for its extreme sensitivity to a blow, for this will create fresh surfaces which are unstable. The solid reaction gives rise to reaction chains which are infinite in length when the surface is free from adsorbed gases

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W E LATCHEM

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A Further Reappearance of the Second Red-Eye Mutation in *Gammarus*

THROUGH the kindness of Mrs Sexton, of the Marine Biological Laboratory, Plymouth, I was able to obtain a stock of a new mutation producing red, instead of the normal black, facets in the eyes of the amphipod *Gammarus chevreuxi*, Sexton. It had appeared in the first F_2 of a pair from a dredging taken in Chelson Meadows, near Plymouth, about a year ago, and my intention was to make a study of the effects of temperature on this mutant similar to that made by E B Ford and J S Huxley (1927) on the first red eye mutation For this purpose it was necessary to cross the new form with the red-eye mutations which had previously appeared, in order to determine whether or not it was homologous with any of them

The following results have now been obtained When crossed with the first red-eye stock (r_1), all the F_1 offspring had black eyes With the second red-eye stock (r_2), the following F_1 families have appeared (*a*) One black- and sixteen red-eyed young (*b*) With different parents . a single red-eyed specimen, about six weeks after mating (*c*) With different parents again . three red-eyed young about a fortnight after mating, and a further seven red-eyed ones about three weeks later

Doubtless the explanation of the single black-eyed individual in the first family obtained with the second red-eye stock, is that some of the sperms from the previous mate of the female had remained behind and fertilised one or more of the eggs, causing the appearance of a heterozygous black-eyed specimen—not an unusual phenomenon in *Gammarus*. The long period elapsing between the separation of the female and the appearance of the young precludes such an occurrence in the second brood, while in the last instance, the female, after producing the first red-eyed family, had been mated with a homozygous black-eyed male before being again given a red-eyed mate, so that if any sperm had been left over from a previous mating some of the second family would have had black eyes ('black' is dominant to 'red'). The present gene therefore proves to be a reappearance of the second red-eye factor.

From the results already obtained by Sexton and Clark[1] we may infer that this recessive gene is somewhat widely spread in the wild population, and any further information on this subject appears to be of value.

K W YARNOLD

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March 16

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[1] Sexton, E W and Clark, A R, NATURE, 131, 201, 1933

Composition of Interveinal Mosaic of Potatoes

IN a recent paper from Madison, Wis, Koch and Johnson[1] state that they have found in interveinal mosaic of potato received from this laboratory a "streak" (Table VII) which is presumably identical with the new virus described in the text (p 45) as "potato streak virus". We had already found in 1933 and 1934 that this interveinal mosaic results from the combined action of viruses of two different types, one of which may correspond to the streak of Koch and Johnson, since there is no present evidence of a further constituent In the circumstances, it is desirable to publish this note although the work is not complete

One of the constituents of interveinal mosaic is a virus of the X-type which has no known insect vector The other constituent is selectively transmitted under certain conditions by the aphis *Myzus persicæ*, Sulz, contrary to the conclusion of Koch and Johnson regarding their virus, and it has been isolated both in this way and by passage of interveinal mosaic through the potato variety Arran Crest, in which the X-virus does not survive

The virus thus separated by the two methods sometimes produces on the foliage of President potato a slight transient mottle, but one of its diagnostic features is the production of irregularly arranged necrotic blotches in the cortex and pith of the tubers of this variety, and it is regarded as responsible for this symptom in interveinal mosaic Koch and Johnson make no reference to this, and they were consequently not in a position to know that the virus is related to, if not identical with, that causing phloem parenchyma necrosis (or pseudo-net necrosis) as defined by Quanjer, Thung and Elze[2,3] Its full identity, however, has not yet been satisfactorily established, and it is provisionally entitled the 'tuber blotch virus'.

Another diagnostic character of the virus is its power of combining with simple mosaic (virus X), thereby intensifying it to interveinal mosaic, and the latter has been synthesised in this way. This reaction can only follow in a variety which is tolerant of both viruses, for if it is intolerant of either, 'streak' results Thus the simple mosaic element alone would cause this symptom in Arran Crest, while the tuber blotch virus was presumably responsible for the 'streak' which Koch and Johnson produced in the experimental Bliss Triumph, since the plants already carried the equivalent of simple mosaic.

The tuber blotch virus is readily inoculable into tobacco (var. White Burley) and *Datura Stramonium*, but it is carried by the latter and also probably by the former. It does not survive nine days *in vitro* at room temperature, and does not pass the L3 or L5 Pasteur-Chamberland filters, while the X virus does so, and has been readily separated in this way.

Whatever the identity of the tuber blotch virus turns out to be, it is unfortunate in the present circumstances that Koch and Johnson should have given the virus they worked with the new name of "potato streak virus" This term is likely to lead to further confusion, since it had been used previously in a looser sense, and at the present time the name 'streak' as applied to potato viruses is devoid of meaning, seeing that the majority, if not all, of them produce streaking on intolerant varieties

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PHYLLIS CLINCH

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[1] *Ann App Biol*, 22, 37 54, 1935
[2] *Meded Landbouw*, *Wageningen*, 33, 1929
[3] *Phytopath*, 21, 577–613, 1929

Physiological Polarity in *Aspergillus*

WORKING with a certain strain of *Aspergillus nidulans* (Eidam), Winter, I have proved and described a particular type of 'physiological polarity'[1]. It is important to verify this polarity with other strains of the same species

I should be obliged therefore if mycologists would send me specimens of *Aspergillus nidulans* with perithecia, and indication of the origin I require the fungus from its natural sources, and not from strains found in the laboratory, as it is necessary that I should carry out the isolation myself I should be grateful to have the material sent c/o Centraalbureau voor Schimmelcultures, Baarn, Holland, where I am working at present

P HENRARD

Collège philosophique,
Eegenhoven, Louvain
March 13.

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[1] "Polarité Hérédité et Variation ches diverses espèces d' *Aspergillus*," *La Cellule*, 43, 350–424, 1934

Preparation of Diazomethane and its Homologues in the Free State

WE have recently prepared for the first time an extended series of the homologues of diazomethane, but only in ethereal solution[1]

For the systematic study which we contemplate of the physical and also of the chemical properties of this series, however, it is requisite that the several compounds should be available in the free condition. We have now achieved this in a number of instances by decomposing the nitroso-β-alkylamino*iso*butyl methyl ketones in a reflux apparatus at 70° under somewhat reduced pressure in presence of a small quantity of anisole, by means of sodium benzylate, and obtained yields which in certain cases even surpass those already recorded; for example, of diazomethane 81 per cent, of diazoethane 64 per cent, of diazopropane 59 per cent, of diazobutane 46 per cent.

D. W. ADAMSON.
J. KENNER.

Department of Applied Chemistry,
College of Technology,
Manchester.
April 12.

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[1] *J. Chem Soc*, 286; 1935

Points from Foregoing Letters

SIR JOSEPH LARMOR makes critical comments on theories of magneto-optic rotation and suggests that valuable information might be obtained by the application of modern technique to the measurement of the intensity across the Zeeman spectral components (spectrum lines resolved and polarised by the action of a magnetic field)

Artificially produced radioelements can be partially separated by carrying out the transmutation in the presence of an electric field, according to Prof F A Paneth and Mr J W J Fay Using a gaseous arsenic compound which by bombardment with neutrons gave radioactive arsenic, they were able, by the application of an alternating electric field, to concentrate 20,000-fold the radioactive material produced

Accepting the view that primary cosmic rays consist of two groups of particles, namely, positive and negative electrons and positively charged hydrogen nuclei, Dr Pierre Auger indicates that, as they penetrate through matter, their interaction with elements of low and high atomic weight leads to the production of secondary phenomena, such as the penetrating radiation and electron showers observed

The power of proteins and similar substances (choline, betaine) of decreasing the fat content of liver is discussed by Prof C H Best and Messrs M E Huntsman and J H Ridout They give results of experiments on rats which lead them to believe that Channon and Wilkinson have emphasised unduly the effect of moderate under-nutrition on the deposition of liver fat; they find that slight change in body weight does not affect the liver fat balance

Mr Alec H Laurie, who has just returned from a whaling expedition, describes personal observations indicating that whales do not fill their lungs with water when diving (to prevent caisson sickness due to liberation of dissolved nitrogen) Mr Laurie's previous experiments with whale blood have shown that it has the property of using up dissolved nitrogen

The freezing point of a solution is no guide to the osmotic pressure it will exert across an animal membrane Mr J Z Young therefore advises that solutions used for hardening or 'fixing' tissues of sea animals should contain the saline constituents of sea-water in the same concentration, in order to prevent distortion or bursting of the cells due to penetration of water.

Dr W N Bond offers further evidence in support of his suggestion that the cause of the discrepancy between experiment and Eddington's theoretical value, *M/m*, for the electron, is that experiment measures not *e/m* but 136/137 *e/m* It is suggested further that since X-ray determinations and Millikan's method give different values for the electronic charge, approximately in the value 137/136, the reason for this lack of agreement is the same as in the first case, namely, faulty analysis of a 'system' into 'parts'

Mr. K Mendelssohn and Miss Judith R Moore describe the magnetic properties of a lead-bismuth alloy at temperatures near the absolute zero, when it becomes supra-conducting A possible explanation for the phenomena observed is that the 'threshold value' (temperature at which supra-conductivity begins) is high in some parts of the alloy while the main part has about the same value as pure metals Such a model would act like a fine supra-conducting sponge, the meshes of which are formed by annular regions of high threshold value impenetrable for magnetic flux that has once been caught in them

The electrical resistance of very pure aluminium just before it becomes supra-conducting has been investigated by Mr H A Boorse and Dr H Niewodniczański, between 4 2° and 2 2° K, the resistance is constant

Dr F P Bowden and Mr S H Bastow have measured the resistance to flow of thin films of water and of soap (ammonium oleate) solution, and have failed to confirm the rigidity deduced by Derjaguin from observations on the resistance offered by water to the movement of an oscillating lens This, they believe, disproves the view that oriented chains of water molecules may extend to a distance of 5 μ from the surface

Using radioactive isotopes as indicators, Mrs Alice Leigh-Smith and Dr H O W Richardson find that in compounds of metals with organic radicles, exchange of atoms of the same atomic number occurs without the break-up of the molecules

A method of determining minor quantities of water, such as are produced during the partial decomposition of some organic compounds, is described by Prof W Swietoslawski. It depends upon the lowering of the boiling point of azeotropic mixtures of certain organic liquids (mixtures which distil in a constant ratio) produced by small amounts of moisture The method has been applied by Mr M Wojciechowski to the determination of small amounts of substances adsorbed at solid surfaces

By means of a new optical method, Prof. H Falkenhagen and Mr Ch Bachem have measured the compressibility of solutions They find a linear relation between the apparent molal compressibility and the square root of the concentration of the electrolyte, in accordance with Gucker's theory, but the relation does not hold for non-electrolytes, such as sugar

Dr L F Richardson directs attention to a mathematical formula in which he has attempted to express the armament race between opposing nations or groups of nations in terms of a "defence coefficient", a "fatigue and expense coefficient" and a quantity depending upon dissatisfaction with treaties

Messrs F T Farmer and J A Ratcliffe have investigated the application of Appleton's theory of the ionosphere to radiation of wave length greater than the critical value of 214 m. Observation of the ordinary and extraordinary reflected rays which have partially penetrated the *E* and *F* reflecting layers confirms the theory, and suggests that reflection occasionally occurs from an intermediate region at 150 km

Mr J. B. Loughnane and Miss Phyllis Clinch state that interveinal mosaic disease of potatoes is due to the combined action of two viruses, one of which is transmitted by the green fly *Myzus persicæ*, whilst the other has no insect carrier.

Mr. D. W. Adamson and Prof J. Kenner report the preparation, for the first time, of a number of compounds belonging to the diazomethane ($C_nH_{2n}N_2$) series These are highly reactive, poisonous and explosive substances.

News and Views

Award of the Mueller Medal to Dr. R. J. Tillyard, F.R.S.

THE Mueller Medal of the Australian and New Zealand Association for the Advancement of Science was presented to Dr R J Tillyard, Chief Commonwealth Entomologist, at the recent annual meeting of the Royal Society of Australia held at Canberra. This medal, which was established in 1896 by a group of scientific workers in Victoria, commemorates the services to Australia of Baron Ferdinand von Mueller, and is the premier award in the gift of Australian men of science According to the *Canberra Times*, Dr. A. B Walkom, general secretary of the Australian and New Zealand Association, made the presentation. In his address, he recalled the names of previous recipients of the Mueller Medal, among whom have been J. H Maiden, Leonard Cockayne, W. Howchin, Sir Douglas Mawson, Sir Edgeworth David and Prof. Wood Jones Dr. Tillyard, he said, has many notable investigations to his credit, in particular, he has studied the biology of the dragonflies, the wing venation of insects and the determination and classification of fossil insects He has also published a valuable and comprehensive textbook on the insects of Australia and New Zealand Dr Tillyard's work in entomology, in both New Zealand and Australia, has been of outstanding value, establishing principles and facts of wide interest and great importance

Presentation to Sir Denison Ross

AT the recent annual anniversary general meeting of the Royal Asiatic Society, Sir Denison Ross, director of the School of Oriental Studies, London, was presented with the Triennial Gold Medal for his work in forwarding Oriental research during the period concerned The presentation was made by H.E. The Iranian Minister, a very happy arrangement as a great deal of Sir Denison Ross's time has been devoted to the study of the Persian language and Iranian dialects He was the guest of the Iranian Government on the occasion of the festivities held in Iran, in honour of the millenary of Firdausi, the national poet of Persia. The gold medal trust was founded in 1897 to commemorate the Diamond Jubilee of Queen Victoria. The selection of the recipient is made by a special committee appointed by the president and council of the Royal Asiatic Society for the purpose, from among their number The previous recipients have included Prof. E. B. Cowell, E W. West, Sir William Pope, V A. Smith, A. H. Sayce, D. S. Margoliouth and Sir Aurel Stein. In mentioning some of Sir Denison's services, the Iranian Minister dwelt on his love of Persian studies and his constant travel in the East He thought that Sir Denison must own a special kind of magic carpet from the "Arabian Nights", for he attended the Firdausi celebrations in Teheran and elsewhere, but was able to reach London in time for Firdausi week here. His studies had kept alight the torch of Oriental learning in England and India.

U.S. National Academy: Elections and Awards

IT is announced by Science Service, Washington, D.C , that the following have been elected members of the U S National Academy of Sciences Dr N. L. Bowen, Carnegie Institution of Washington, geologist; Dr. C M. Child, the University of Chicago, zoologist; Dr. G E Coghill, Wistar Institute, Philadelphia, chemist; Dr James Ewing, Memorial Hospital, New York City, pathologist; Dr. M. L Fernald, Gray Herbarium, Cambridge, Mass , botanist, Dr Harvey Fletcher, Bell Telephone Laboratories, New York City, physicist, Dr Ross Aiken Gortner, University of Minnesota, chemist, Dr. E A. Hooton, Harvard University, anthropologist, Dr. J C Hunsaker, Massachusetts Institute of Technology, aerodynamist, Dr. Walter S. Hunter, Clark University, psychologist; Dr Dunham Jackson, University of Minnesota, mathematician, Dr Chester R Longwell, Yale University, geologist, Dr H C Urey, Columbia University, chemist, Dr. J. H. Van Vleck, Harvard University, physicist. New foreign associates of the Academy are Dr J. S Haldane, director of the Mining Research Laboratory and honorary professor in the University of Birmingham, and Dr Jules Bordet, director of the Pasteur Institute, Brussels Dr Frank R Lillie has been elected president of the National Academy of Sciences for a term of four years He is dean of the division of biological sciences at the University of Chicago and president of the Woods Hole, Mass., Marine Biological Laboratory

THE following awards have been made by the National Academy of Sciences *Public Welfare Medal* to Prof. August Vollmer, of the University of California, for his work in police administration; *Daniel Giraud Elliot Medal* to Dr James P. Chaplin, of the American Museum of Natural History, for his work on the birds of the Belgian Congo, *Henry Draper Medal* for astronomy to Dr J S. Plaskett, director of the Astrophysical Laboratory at Victoria, British Columbia; and *Agassiz Medal* for oceanography to Prof. Haakon Rasberg Gran, of Oslo

"Backward Tracts" in the India Bill

FURTHER consideration was given to the position of the aboriginal tribes under the provisions of the India Bill in Committee of the House of Commons on May 9 and 13, when an amendment to Clause 6 was moved by Mr. Cadogan (Finchley, U) proposing the extension and modification of the excluded and partially excluded areas named in the schedule thereto. The "anthropologists", as Mr. Winston Churchill happily termed the supporters of the amendment, urged with vigour the necessity for a much wider application of the principle of exclusion, by which jungle and hill peoples living under tribal conditions remain outside the jurisdiction and administration of the Provincial Governments and are entrusted to the care of the Federal Governor. It is evident that while the Government is in sympathy with the principle, difficulty has been felt as to the limits to which its application is a practical possibility. The Under Secretary to the India Office (Mr. Butler) explained what those difficulties are. While mainly administrative, especially where 'pockets' of aboriginal tribes live among a more advanced population, they also entail the possibility of a retrocession where some cultural advance has already been made.

LORD EUSTACE PERCY pointed out that it had not been possible to provide the House with the detailed information requisite for a decision on the detailed amendment of the schedule, and it is probable that the wisest course was followed in the adoption of the suggestion of the Attorney General (Sir T. Inskip) to withdraw the question from immediate discussion by the omission of the schedule from the Bill and the preparation of an Order in Council for submission to the House after all necessary information had been obtained. Members thus have the assurance that they will at least be in full possession of the facts, and the "anthropologists" will be in a position to gauge how far it will be possible to avert the danger of oppression, which is feared, through clash of culture, under the Provincial Governments. In the meantime, the important pronouncement has been made that the policy of the Government in dealing with the question of the aboriginal tribes is assimilation rather than segregation.

Aborigines and the Law in Australia

IT is evident that public opinion in Australia has been stirred by recent decisions of the courts in criminal cases in which aborigines have been implicated. Two aborigines undergoing sentence for killing a goat have been released from Port Augusta gaol, according to an Adelaide cable in *The Times* of May 7, by the Governor of South Australia, Major-General Sir William Dugan, in response to a petition from the Aborigines Friends Association. It was stated that the crime was committed under stress of great hunger and in ignorance of the white man's laws. This decision has renewed interest in the case of the two aborigines recently condemned to ten years imprisonment for killing a fellow-tribesman who had revealed ritual secrets. No doubt an effort will be made to secure some modification of the decision in this case also. These, unfortunately, are not the only cases affecting aborigines which have attained notoriety and caused misgiving as to the judicial procedure in dealing with crimes and misdemeanours of aborigines. They point to the need of a special tribunal and a penal code *ad hoc*, which will take fully into account aboriginal culture and outlook on life, property and society. It is surely anomalous that while the Federal Government, for example, fosters continued tribal existence by securing to the aborigines the rights of access to traditional hunting grounds and water-holes, it forces them to abrogate tribal custom by submission to a code and tribunal appropriate to the civilisation and outlook of the white man.

Excavations at Tell el-Amarna

IN the season's excavations of the Egypt Exploration Society at Tell el-Amarna, which have recently been brought to a close, the most notable achievement has been the completion of the exploration of the great palace of Akhenaten, or rather of what was left of it by the spoilers by whom it was destroyed at the collapse of the Aton religion and the abandonment of the city. The building was of a remarkable size. It has now been shown by the recent excavation to have been little less than a kilometre in length. At the south end was a vast hall in which the roof was supported by six hundred square pillars of mud brick. The walls had been covered with faience tiles in green with a characteristic decoration of inlaid white daisies. Among the relics found in this building were a large number of fragments of huge statues. These evidently had occupied a position along a plaster pavement leading to a columned hall. They had apparently stood on the oblong bases which were found at intervals along this passage. It is to be concluded that the statues were hacked to pieces when the palace was destroyed. Near the palace entrance was a well-preserved copper crowbar, which, no doubt, had been used as one of the implements of destruction. Among the examples of the sculpture, for which the site is now famous, this season's finds included a remarkably fine head of Akhenaten executed in black granite.

Bronze Age Burials near Bournemouth

A REMARKABLE example of a bronze age barrow is now in course of excavation at Dudsbury, near Bournemouth. Its method of construction is believed to be unique in the British Isles. Beneath the sand and gravel forming the surface of the heath on which it is situated, it is stated by a correspondent of *The Times* in the issue of April 26, that Col. C. D. Drew, who is conducting the excavation, has found a mound of turves, three feet thick at the centre. No skeletal remains were found in this mound, which constitutes the primary interment. For this, the acidity of the soil is held responsible, all animal remains being destroyed by its action. A secondary interment took place in the top of this mound, and above it was piled a further six feet of turves with a top dressing of other soil. In the secondary interment was an inverted cinerary urn which had covered the ashes of the incinerated body. It is of Middle Bronze Age type (*c.* 2,000–1,500 B.C.) and has an ornamentation of three horizontal grooves running around it and finger-nail marks on the rim. It is about 16 inches high and 12 inches in diameter. It will be deposited eventually in the Dorchester Museum.

Progress in Aero-Engine Design

THE Bristol Aeroplane Company has just completed the official tests of an improved engine, to replace the standard Pegasus III air-cooled radial engine now in production. This engine, known as the Pegasus X, gives an output of 920 horse-power at ground-level, and maintains 875 horse-power at 6,000 ft. altitude, with a remarkable weight of only 995 lb., completely equipped. This figure of 1·08 lb. per H.P. is the least weight/power ratio ever reached in a production type of aero engine, designed to stand up to the conditions of everyday use. The Rolls-Royce racing engine produced for the last Schneider Trophy race had a ratio of only 0·7 lb. per H.P., but this was not a production type. The fuel consumption of the Pegasus X is also as good as any other type in existence; earlier air-cooled engines compared badly with contemporary liquid-cooled types in this respect. It also standardises a controllable pitch airscrew, carrying the fittings for the hydraulic control gear integral with itself. It is interesting to note the progress in weight reduction in aero engine practice since the adaptation of the internal combustion engine to flying requirements. In 1903 the Wright Bros. original engine weighed 12·7 lb. per H.P. In 1913 the average was about 4·9 lb., while during the War period, 1914–18, rotary engines were produced as low as 2·5 lb. The lowest weight to-day, previous to the new Bristol engine, was 1·15 lb. per H.P.

Increase of Power Output in Aeroplanes

SCIENCE SERVICE, of Washington, D.C., reports that, in future, U.S. Army aeroplanes will be delivering approximately 70 per cent more power per pound of gasoline than was the case seven years ago. In 1928 an increase of 33 per cent in power output was obtained by alteration of engine design to utilise 92 instead of 50 octane gasoline; and now a further increase is envisaged by the substitution of special lead blended iso-octane for the 92 octane gasoline. Petroleum will still be used as a raw material in the production of this fuel, but the molecules will be 'torn down' and 'rebuilt' into new fuels. The composition of such fuels will be half *iso*-octane, which is now being manufactured in substantial quantities by several refineries, and half good quality ordinary aviation spirit with the addition of 'ethyl'. The cost per gallon of the final product will be higher than that of present aviation fuels, but since its power per pound is greater it ought in the long run to prove more economical. The practical result of its utilisation will be to enable aeroplanes to fly farther and faster without increasing the weight of fuel carried.

Parliamentary Science Committee

A MEETING of the general committee of the Parliamentary Science Committee was held at the House of Commons on May 14, Sir Arnold Wilson in the chair. It was reported that recent accessions to the list of bodies allied to the Committee include the Institution of Civil Engineers, the Institute of Chemistry and the National Veterinary Medical Association. In the period reviewed in the Honorary Secretary's report, special mention was made of the Committee's successful efforts to secure consideration of the claims of scientific research in connexion with the Metropolitan Water Board Bill now before Parliament. Other activities reported included certain aspects of the Government of India Bill, the exemption from income tax of funds expended on industrial research, and the claims of science and technology to representation in the higher administrative posts in Government service. Sir Arnold Wilson addressed the Committee and in his concluding remarks said: "It will take time to evolve a suitable mechanism and a live organisation, but, if sufficient support is forthcoming and the membership widened to cover science as a whole, there is no reason why we should not be of real use and value to the nation; for it is in Parliament, and nowhere else, that the balance between science and ethics has to be settled, day by day, in terms of statutes and regulations".

British Postgraduate Medical School

H.M. THE KING formerly opened the British Postgraduate Medical School at the L.C.C. Hospital, Ducane Road, Hammersmith, on May 13. It will be recalled that the School arose out of a recommendation of a committee under the Earl of Athlone that London should have a centre for medical postgraduate work comparable with the great continental medical schools, which should be attached to the University and receive substantial Government support. By the co-operation of the Government, the University of London and the London County Council, one of the hospitals under the last-mentioned body was allocated and specially enlarged and equipped for the purpose (see NATURE, April 21, 1934, p. 600). Their Majesties were received by Sir Austen Chamberlain, chairman of the governing body of the School, who described its inception, stating that the School has three great tasks: to enable general practitioners to become familiar with the latest developments in diagnosis and treatment; to provide instruction for graduates undertaking specialist studies; and to promote research and advance medical knowledge. The King, in his reply, said that "The provision within the University of London of a new centre for clinical teaching marks a notable advance in the continuous effort of the medical profession to increase its capacity for service to mankind". He concluded by expressing the hope that "this school, with its happy union of ward and laboratory, university and local authority, drawing students and teachers alike from all parts of our Empire, and . . . from regions even more widely spread . . . [may] play an imperial rôle in the winning and dissemination of medical knowledge, in the relief of suffering . . . and in enabling the doctors of all lands to come together in a task where all must be allies and helpers."

Mechanisation of Industry

IN an article in the Royal Jubilee number of *Engineering* published on May 3, Sir Richard Redmayne says that the mechanisation of industry tends to increase both the wages and the time available for leisure of the operatives, and thus increases their material welfare without the application of what are known as 'revolutionary methods'. He illustrates this progress by what is happening in the coal-mining industry. The hewing of coal by pick and filling it into a tub by shovel, in a more or less confined space, is work of the most arduous nature The great expansion during recent years of mechanical coal cutters has made this work comparatively easy In 1900 only 1·5 per cent of the British coal output and 25 per cent of the output of the United States was cut mechanically In 1932 this had risen to 38 per cent in Britain and 68 per cent in the United States In the Ruhr coalfield the mechanical pick has found great favour, in 1913 only 2 2 per cent was cut mechanically, now 90 per cent is, 84 per cent being cut by mechanical picks and 6 per cent by mechanical coal cutters The transport of the cut coal from the coal face to the shaft bottom was almost as laborious as 'getting' the coal Now, owing to the perfection of electrically actuated plant, not only is the haulage on the main roads carried out electrically, but in the secondary roads also it is replacing horses and ponies So far as creation of wealth and increase of leisure and comfort of the mass of mankind are concerned, the engineer has taken a leading part During the last 130 years, wages in coal-mining have risen 3 2 times and the daily time of labour has been decreased 37 per cent, the return on the capital remaining on the average stationary. The chief beneficiary under the system of mechanisation has been the manual worker There is no doubt that the rationalisation of industry tends to decrease the number of employees, but Sir Richard Redmayne thinks that the lowering of the price of the commodity, its more effective distribution leading to the increase of new industries, together with the increase in wages and leisure creating an increased demand, will result in more than the absorption of the overplus of labour

Unemployment among Young Persons

THE International Labour Office estimates that of about 25 million unemployed throughout the world, about one fourth, or 6–7 million, are young persons less than twenty-five years of age In Great Britain the percentage between fourteen and twenty-four years old was 30·2 per cent in 1931, a figure which indicates the significance of the National Jubilee Trust inaugurated by the Prince of Wales The corresponding figure for Switzerland in July 1934 was 15 per cent, but for Hungary in 1930 it reached 42 per cent; in Italy in 1932, 41·5 per cent of the unemployed were between fifteen and twenty-five years of age. These figures indicate the quantitative significance of the discussions on unemployment among young persons at the International Labour Conference opening at Geneva on June 4 They do not, however, reveal the demoralising effects of prolonged unemployment, which are much more serious among young than among older persons. Steps already taken by various countries to deal with this position are indicated in a report prepared by the International Labour Office as a basis for the discussions. The report suggests that most of the measures to be taken to ameliorate unemployment among young persons call for pooling of experience rather than for the drafting of a convention Particular stress is laid upon the raising of the school-leaving age to fifteen years, the creation of an increased number of technical schools, the organisation of vocational training centres in connexion with public employment agencies and the establishment of centres for recreation, physical training, etc

Molecular Structure of Dielectrics

SIR WILLIAM BRAGG chose the molecular structure of dielectrics as the subject of the twenty-sixth Kelvin Lecture delivered on May 2 to the Institution of Electrical Engineers He pointed out that the properties of dielectrics depend on their composition and on the arrangement of their atoms and molecules During the past twenty-five years, men of science have used X-rays to study the structure of various substances, and engineers by other means have discovered many of the factors which govern the properties of dielectrics. It is now necessary that the two classes of workers should come together and pool their resources in making further advances It is sometimes thought that X-rays are only of use for examining the structure of crystals, but it has to be remembered that crystallisation is a property of all substances The crystal is used to obtain electron maps of the image of a single molecule and these maps enable us to find out the electron densities in its various parts. It is possible in many molecules to measure the exact distance from atom to atom, and to determine the way in which they are linked together to form the molecules. This method of attack can be used even when the molecules are not so definite in shape as they are in a crystal Sir William pointed out the analogies between the properties of proteins and those of dielectrics and laid stress on the recent work done at Leeds by Mr. W. T Astbury. Once the basic theory of dielectrics is determined, rapid progress will be made in practical applications. It is fortunate that the researches in the pure science of atoms and molecules and the many technical investigations now being carried on are feeling their way towards each other.

The New Commonwealth Society

ACCORDING to the annual report of the *New Commonwealth* for 1933–34, a clearer demarcation will in future be drawn between the research and propaganda activities of this organisation. Educational and propaganda work will be undertaken by the New Commonwealth Society, which will continue to be subdivided into an international section and the various national sections. Brief reports of the activities of all these sections are included, which indicate the extent to which the scientific study of international affairs is being encouraged in this way. The scientific investigations hitherto carried out by the Research Bureau of the International Section will now be carried out by the New Commonwealth Institute. These activities are guided by an Advisory Research Committee, which includes among its members Major-Gen Sir F. Maurice, Brig.-Gen. E. L Spears, Prof. A. Zimmern, Prof N J. Baker, Prof H. V. Temperley, President N B Butler, M. Nicolas Politis. This Committee will advise upon research work on the principles of international relations, questions of international justice, law and equity, and problems of international security. The publications of the Institute will include monographs and a quarterly review in English, German and French, and preparations are being made for the publication of a yearbook. The work is largely carried out by means of circular letters, but it is also proposed to hold conferences twice a year in different centres. A series of fortnightly 'round table' discussions has also been initiated.

Training for Industrial Management

IN a report entitled "Three Years' Experience and Results in the Training of Scientific Men for Industrial Management" (57 Gordon Square, London, W C 1), Mr. W. R. Dunlop describes the work which he has carried out in providing facilities for training in this subject on the lines of personal and individual tuition, and more recently by correspondence. The courses, he explains, were not undertaken in the expectation of obtaining spectacular results; but experience has shown that scientific and technical men are definitely interested, and that those who have taken full advantage of the training have derived substantial benefit in one way or another. A difficulty has been to get something out of the students as well as putting something in. It has been hard to make chemists in particular understand that management is not a subject but an activity, and that action, energy and initiative as well as passive absorption of knowledge must be demonstrated in a course of training. Chemists in some cases appear to suffer from an 'inferiority complex' in regard to expressing opinions on matters outside their immediate province, while on the other hand many engineers, especially mechanical engineers, tend to go to the other extreme.

Public Health in British Colonies in 1932

THE fourth Supplement to the *Tropical Diseases Bulletin*, December, 1934, contains summaries by Dr. Harold Scott of medical and sanitary reports relating to the year 1932 from British colonies, protectorates, and dependencies. The summaries give for each country the year's record of vital statistics, maternity and child welfare work, school hygiene, general sanitation, housing and town planning, etc., followed by particulars of the tropical diseases occurring in them, and the measures taken locally to combat them. The records show, on the whole, that in spite of retrenchments of medical staffs and curtailment of expenditure on public health services, the general health of the English communities has been well maintained, and no appreciable increase of sickness has occurred in the native communities. Retrenchment has had the effect of bringing to the fore the question of the local training of natives for medical duties. In the Gold Coast, a scheme for the training of nurse-dispensers has been instituted, and elsewhere medical schools exist where native practitioners have been successfully trained.

Ross Institute Industrial Advisory Committee

A MEETING of this Committee, at which the chairman, Mr G H Masefield, presided, was held on January 29 last at the rooms of the Indian Tea Association. The meeting was addressed by Sir Malcolm Watson, who described some of the antimalarial measures that have been undertaken in Southern Rhodesia, Beira and some of the Gold Coast mines, by Mr A Wigglesworth, who raised the question of malarial conditions on sisal estates, and by others. Dr Ramsay, of the Ross Institute in India, mentioned the 'eye fly', which is not only a nuisance but also a danger, as it transmits catarrhal conjunctivitis, and against which no effective measures are known except protection by means of wire gauze spectacles. Sir Malcolm Watson directed attention to a booklet on the prevention of malaria which is distributed free to those residing in, or proceeding to, the tropics. The Ross Institute, which is amalgamated with the London School of Hygiene and Tropical Medicine, is the medium through which industries in the tropics keep in touch with the work of the combined bodies and seek advice, and some £15,000 are required annually from voluntary subscriptions for propaganda work and appeals.

Microscopes and Accessory Apparatus

IN the 1934 edition of the catalogue issued by Messrs Carl Zeiss (London), Ltd (37 Mortimer Street, London, W.1), after an excellent introduction upon the theory of the microscope, the series of microscope stands manufactured is described. The design of the microscope stand has substantially altered in recent years, and the usual form now adopted consists of a broad base which supports a one-piece limb for carrying the illuminating system, the stage and the tube. This one piece limb is in the form of a segment of a circle with a deep central recess. This recess serves as a handle, and provides ample range for a large stage. Another convenient modern device is the inclined tube, single or binocular, which can be fitted to most of the models, in some of which the fine-adjustment head is located in the tilting axis. A large range of Huygenian and compensating eyepieces, and achromatic, fluorite and apochromatic objectives, are manufactured. Petrological and other types of special stands, magnifiers, hæmacytometers, micrometers, micro-manipulator, photomicrographic cameras and other accessory apparatus are also listed.

Research on Bird Migration

THE German Government has issued an announcement referring to the work of the German bird migration research stations—in Heligoland and at Rossitten—where rings are attached every year to the feet of more than 160,000 migratory birds. The rings are inscribed with identification numbers and with the address of one or other of the stations—"Vogelwarte Helgoland" or "Vogelwarte Rossitten" respectively. The stations are anxious to receive reports of the finding of these birds in any part of the world with the view of gaining further information as to bird migration and other phenomena of bird life They will gratefully acknowledge all such reports, and are prepared to furnish in reply information not only as regards the bird in question, but also as regards their work generally Reports will be sufficiently addressed if directed to Vogelwarte Helgoland, Germany, or Vogelwarte Rossitten, Germany

Federation of Scientific Societies in Australia

THE Australian National Research Council, having come to the conclusion, at a general meeting last January, that it is not properly fulfilling its function as a national body representative of scientific thought and endeavour, will, during this year, examine the possibilities of effecting a federation of the various State Royal Societies, the Linnean Society of New South Wales, and a number of professional organisations such as the Australian Chemical Institute, the Institute of Physics, the Institution of Engineers and the Australian Veterinary Association The federation will be confined to bodies concerned with the physical and biological sciences No constitution has yet been suggested, but the general proposal is that each constituent member shall retain its independence as at present and shall have the right to representation on the Federal Council. The nature of the representation and the definition of duties of the council will be the subject of discussion at a conference of delegates from the interested societies, to be called later by the present National Research Council

Announcements

THE council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane Prize for the period 1932–34 to Dr A. E. Cameron, lecturer in entomology, University of Edinburgh, for his publications in entomology, including his recent paper in the *Transactions*, "The Life-History and Structure of *Hæmatopota pluvialis* Linné (Tabanidæ)"

THE Prime Minister will open a Noise-Abatement Exhibition at the Science Museum, South Kensington, on May 31 at 11 a m

THE annual meeting of the Swiss Röntgen Society will be held at Montreux on June 15 and 16 Further information can be obtained from Dr. A. Grosjean, La Chaux de Fonds, Switzerland.

THE sixteenth annual congress of the German Association for Microbiology will be held in Berlin on May 26–28, when the subjects for discussion will be diphtheria and piroplasmiasis.

FOLLOWING the announcement that the Australian Government will erect a laboratory in Melbourne for the Forest Products Division of the Council for Scientific and Industrial Research, Mr. W Russell Grimwade has offered to provide £5,000 for the purchase of additional apparatus and equipment for the new building

THE following appointments have recently been made by the Secretary of State for the Colonies Mr A M. Gwynn, entomologist, Agricultural Department, Nigeria, to be assistant entomologist, Agricultural Department, Uganda; Mr. H. R Binns, to be veterinary officer, Nyasaland; Mr R G. Sangster, to be assistant conservator of forests, Uganda, Mr J Gordon, to be inspector of plants and produce, Gold Coast

THE nineteenth National Baby Week will be held on July 1–7 The subjects for propaganda during 1935 will be the welfare of the pre-school child and the good nutrition of mothers and children On July 1-3 a conference on "Maternity and Child Welfare", organised by the National Association for the Prevention of Infant Mortality, will be held in London Further information can be obtained from the Secretary, National Baby Week Council, 117 Piccadilly, London, W 1

THE Institution of Electrical Engineers is making arrangements for a summer meeting to be held in Belgium, probably on September 8–14. The programme will include excursions and visits to works, and among the towns included in the itinerary will be Brussels (which will probably be the headquarters town and where the Exhibition will still be in progress), Antwerp, Charleroi, Dinant, Langebrugge, Liège, Tirlemont, and also Ypres and other places in the battlefields of the War.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Coal Survey Laboratory, Nottingham—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W 1 (May 20). A veterinary investigation officer at the University of Liverpool—The Registrar (May 24) A principal of the Technical College and School of Art, Colchester—The Director of Education, County Offices, Chelmsford (May 25) A science lecturer in the Yorkshire Training College of Housecraft, Leeds—The Director of Education Education Department, Colverley Street, Leeds (May 28). An assistant in the Natural History Department of the Royal Scottish Museum, Edinburgh—The Director (May 31). A lecturer in geography and geology at St. Luke's College, Exeter—The Principal (May 31). An assistant lecturer in applied electricity and hydro-electric engineering in the University College of North Wales, Bangor—The Registrar (June 8). A lecturer in geography in Armstrong College, Newcastle-upon-Tyne—The Registrar. Assistant engineers for the Drainage and Irrigation Departments of the Governments of the Federated Malay States and Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, London, S W.1.

Research Items

Abyssinian Games. In the course of two expeditions o Abyssinia (1928–29 and 1932), M Marcel Griaule ollected notes on more than four hundred games and recreations of the Abyssinians, of which he has published a selection (Bibliothèque de l'École des Hautes Études Sciences réligieuses, 49, Paris, Lib Leroux, 75 fr) They range from games involving he use of simple musical instruments and simple apparatus such as tops, balls, string, etc , to singing and dancing, games, rhyming, riddles and animal ales Many of the games have a divinatory character, and it is noted that there is throughout Abyssinia a strong belief in the efficacy of children as agents of divination Certain general principles are to be observed in the collection of games in Abyssinia. Between one district and another there may be a marked difference in the games played, or the rules of the same game may differ widely The areas within which any variation obtains may be very restricted In part this is due to the numerous trata of the peoples who have penetrated the country, and also to the consistent policy of the Abyssinians in enslaving and transporting peoples ocially less highly organised than themselves Further, the geographical configuration of the country s responsible for some variation, especially in those games which make use of plants The high plateaux with their relatively cold climate are split up by ow-lying valleys with a climate which varies rapidly n narrow zones from the relatively cold of the heights to tropical in the low lying parts The vegetation varies accordingly and with it the character of the games in which it has a function The variation of climate may also affect the character of the games in other ways It is, therefore, not sufficient o study the games as distributed by provinces Their investigation must be highly localised A urther discrimination must be exercised in accordance with the season , and in others the age and ex of the players has to be noted The solemnity with which some of the games are played, and occasionally their long duration, as in the taboos of Carême, leave it beyond doubt that their origin is eligious or magical

Gulper Eels. The Carlsberg Foundation's oceanographical expedition round the world in 1928–30, and previous *Dana* expeditions under the leadership of Prof. Johannes Schmidt, have resulted in the acquirement of a vast amount of new and valuable oceanographical and marine biological data Papers embodying the results of these various expeditions have appeared in a large number of scientific journals Since the conclusion of the 1928–30 expedition, however, a series of special "Dana Reports" has begun o appear These reports will continue to be published at intervals over a number of years and may be obtained from the Oxford University Press *Dana* Report No 3 on "Les Poissons Apodes apartenant au Sous-ordre des Lyomères" (the so-called gulper eels), by Leon Bertin, deals with the morphology, classification, and geographical distribution of the genera *Saccopharynx* and *Eurypharynx* The relatively very comprehensive *Dana* collection of these fishes consisted of 5 individuals of *Saccopharynx* out of a total of 14 known specimens and of 59 *Eurypharynx* out of the 122 so far known. In the latter genus the author recognises (at least provisionally) two species, and in the former, four species, two being here described *for the first time.* The whole paper is based on the examination of adult fishes A further memoir on larval and post-larval stages is promised

Systematics of Rhizopoda. Henri de Saedeleer (*Mem Mus Roy d'Hist Nat Belgique*, No 60, 1934) divides the Rhizopoda according to the nature of their pseudopodia into three orders, the first two of which were already defined, Lobosa, Filosa and Granuloreticulosa, the third including Rhizopoda with filamentous pseudopodia which may exhibit many or few anastomoses and streaming of granules This third order includes the suborder Athalamia, such as *Gymnophrys* ; Monothalamia, for example, *Allogromia* , and Polythalamia, that is, the Foraminifera which are not included in this memoir The characters of the further subdivisions —families, subfamilies, etc — are followed by accounts of twenty nine genera and fifty-eight species From his studies on a large amount of living material from Belgium, from fresh water and from the seashore, the author has provided useful line drawings of most of the species Four new genera and seventeen new species are described

Empire-Grown Sisal for Marine Cordage. The Imperial Institute has recently published (February 1935 1*s*) a report upon tests carried out in conjunction with the Admiralty of tarred and untarred cordage made from East African sisal As Manila hemp does not absorb tar satisfactorily, such cordage in the past has generally been made from European hemp. In order to investigate the effect of tarring on the durability of sisal cordage, the Admiralty has recently *carried out a further series of experiments* Ropes, three inches in circumference, were prepared from East African sisal, one batch being made in the ordinary way from untreated fibre and another from yarn which had been passed through a bath of Archangel tar Both kinds of rope were exposed to the action of sea water for periods of two, four, six and nine months, their breaking strain being determined at the end of each period It was found that after exposure to the action of sea-water for nine months, the untarred sisal rope had lost 76 per cent of its initial strength, whereas the strength of the tarred sisal rope had fallen only 29 per cent The tests have thus shown that the life of sisal ropes when exposed to sea-water is enormously prolonged by tarring. The Admiralty is therefore considering the general adoption of tarred sisal cordage in place of tarred European hemp cordage, and inquiries are being made as to the extent to which such substitution could be carried out

A Disease of Pomegranate A short paper by H. Chaudhuri and Jagtar Singh (*Trans Brit Mycol Soc* , 19, Part 2, 139–144, January 1935) describes a disease of pomegranate, *Punica granatum* L , in Lahore, India, caused by the fungus *Amphichaeta punicæ*, n sp Infected twigs bore numerous pycnial fruit bodies , and the tree was stunted, but seldom killed Infection experiments proved that the causal fungus was a new species belonging to the genus *Amphichaeta*, for which the name *A punicæ* has been suggested Morphology, cultural characters, and the effect of various external factors on growth of the fungus are described.

An Earthquake Magnitude Scale It is usual to estimate the intensity of an earthquake in terms of some arbitrary scale such as the Mercalli or Rossi Forel The results may however be untrustworthy owing to variations in the nature of the ground the depth of the focus or in some cases to the origin being submarine In a recent paper (*Bull Amer Seis Soc* **25** 1 32 1935) Mr C F Richter shows that a comparison of the maximum amplitudes recorded at different epicentral distances by the Wood Anderson torsion seismometers at the seven stations in South California makes it possible to estimate earthquakes as a whole in terms of a magnitude scale The magnitude of a shock is defined as the logarithm of the calculated trace amplitude expressed in microns with which the seismometer would register that shock at an epicentral distance of 100 km Such magnitudes can be assigned to the nearest half unit or less Shocks of magnitude 1 5 are just strong enough to be felt those of magnitude 4 5 may cause slight damage near the epicentre while those of magnitude 7 5 are at the lower limit of great earthquakes For example among recent Californian earthquakes that of Long Beach in 1933 was of magnitude 6 2 and that of Nevada in 1932 of 7 5

River Dee Flow Records The brochure recently issued by River Flow Records (Parliament Mansions Victoria Street S W 1) on the River Dee (Aberdeenshire) contains extremely serviceable information concerning the water levels rainfall and run off in the basin of that river for the year 1934 There are four introductory statements of an explanatory character dealing with the daily rainfall distribution the Woodend flow gauging station the Cairnton water level station and finally with the diagram records for the year The diagram records four in number with a prefatory map have been designed to obviate the publication of lengthy and numerous tables and each of them covers a period of three months The originals of the diagrams are 2½ times the scale of the plates and prints therefrom are stated to be available if required On the rainfall and run off diagrams the aggregate run off starts from zero on January 1 and amounts to 39 inches by the end of the year The aggregate of rainfall starts with a credit of 0 39 inch which is the minimum residual run off for the water level of January 1 under de saturated conditions The story of the year is briefly the desaturation of the early months shown by excess of run off merging into the evaporation losses of the later spring, followed by the high evaporation losses of the summer and re saturation losses of the early autumn and ending with a see saw of saturation and de saturation during the late autumn and winter There is an interesting appendix on the cost of river flow records showing that an annual expenditure of about £100 will cover the whole scope of the work for a fully equipped flow gauging station on rivers of 100 ft 200 ft in width This expenditure falls roughly in equal proportions under four heads interest on capital expenditure, maintenance observations and tabulation, compilation of completed records, publication

Combination Tones and Modulated Waves H Hazel (*Phil Mag* Jan 1935) has carried out some experiments which clarify the explanation of the famous Helmholtz König controversy on the objective existence of combination tones He shows that the addition of sinusoidal components whether these are sound waves or wireless waves does not produce combination frequencies unless the disturbances are impressed on a non linear system The multiplication of sinusoidal components (modulation) does give combination frequencies which can be detected by a linear arrangement and if two sinusoidal disturbances are impressed on a non linear system, product terms are found in the motion of the latter which correspond to a modulation and hence to the production of combination frequencies

Deuterium Content of Ordinary Water Both the H/D (hydrogen to deuterium) ratio in ordinary water and the question of the existence or non existence of the electrolytic separation of the oxygen isotopes have been subject to some doubt H L Johnston (*J Amer Chem Soc* **57** 484 1935) describes the preparation of deuterium free water (less than 1 D atom to 10^{6} H atoms) by electrolysis and density determinations by a totally submerged float The results correspond with an abundance ratio of 5750 ± 250 for H/D in ordinary water which confirms the figure of 5000 ± 500 obtained by the mass spectrograph by Bleakney and Gould The electrolytic separation factor for O^{16} relative to O^{18} was found to be 1 008 which proves the futility of attempting to prepare pure O^{18} or O^{17} by electrolysis From the H/D ratio of 5750 the atomic weight of normal hydrogen is calculated as 1 00795 on the O^{16} scale or 1 00770 or 1 00775 on the chemical standard of O 16 according to the abundance ratio of O^{18} of Manian Bleakney and Urey or of Mecke and Childs respectively These figures are based on Aston s figure of 1 00778 for H^{1} and Bainbridge s value of 2 01363 for D It may be remarked that Ingold and Ingold have recently reported an abundance ratio of H/D of 9000 (NATURE **134** 661 1934)

Piperidine the Alkaloid of *Psilocaulon absimile* C Rimington research fellow under the Empire Marketing Board reports the isolation of the toxic alkaloidal constituent of *Psilocaulon absimile* N F Br and its identification as piperidine hydrochloride (*S African J Sci* **31** 184 Nov 1934) The Aizoaceæ of which *P absimile* is a member have on occasion caused the death of stock but the chemical investigation of their constituents has received little attention In the present investigation a straightforward acid alkali extraction process isolated the alkaloid, which was identified as piperidine by the preparation of the picrate aurichloride and platinichloride The picrolonate was also prepared The pharmacological action of the salts on rabbits and frogs confirmed the chemical identification The investigation has both chemical and botanical interest since piperidine itself has not hitherto been found as a naturally occurring plant alkaloid But the importance of the work lies in its possible economic application and in the additional evidence it provides of the wisdom of the policy of subsidising research which the Empire Marketing Board adopted One pound of piperidine can be obtained from 10 kilos of the dried plant with the aid of such cheap chemicals as caustic soda, hydrochloric acid chloroform and light petroleum. Piperidine has certain commercial uses and the high cost of the synthetic substance offers scope for the commercial production of the natural alkaloid from *Psilocaulon* It may be no more than a coincidence that the list price quoted in the paper is £6 8*s* 0*d* a lb while to-day it may be obtained for £2 9*s* a lb

Cost of German Scientific Publications

THE high prices of German scientific publications, to which reference has been made in NATURE (132, 34 and 540, 1933), are again discussed in *Angewandte Chemie* of March 9 The chief factors in the increased cost are the decreased demand, increased cost of paper, binding, type and setting and illustrations, as well as overhead charges, decreased revenue from advertisements resulting from diminished circulation, the publication of smaller editions to avoid getting out of date, with consequent heavier on costs, and the high discounts afforded to German booksellers. It is asserted that every effort is being made at compression to compensate for the 15–20 per cent greater space normally required for a German book as compared with the same work in French or English, and that the 'Munster Agreement' of 1933 (between librarians, publishers and the university unions, representing the authors) has in this way already resulted in an estimated decrease of 2,000,000 gold marks in costs of publication

The prices of books and journals have been reduced, but only exceptionally has the cost per page been reduced, chiefly due to the technical costs of production which are not under the publisher's control It is estimated that the cost of setting and printing is about 95 per cent above that of 1913, plates and line blocks are 60 and 150 per cent dearer, paper 12 per cent and bookbinding 100 per cent above the 1913 charges, representing an average increase of 50 per cent, or more for many important books Author's fees have also increased, but are being reduced, and are now little above the pre-War figure This factor, however, reacts adversely on the demand, since authors form an appreciable proportion of the purchasers of scientific works During 1934, imports of foreign journals into Germany decreased 16 per cent in volume as against 12 per cent by value, indicating increased costs of production elsewhere, while exports of German literature decreased by 13·1 per cent in volume and 16½ per cent in value, indicating a fall in German prices

On-costs in particular have increased both actually and relatively, and are still tending to rise owing to industrial conditions and diminished output Publicity charges are more than 50 per cent higher than in 1913, taxation is at least four times as great, rents are 20 per cent, heating and lighting 27 per cent higher, and 20 per cent of the turnover in advertisements has to be contributed to the trade council Postage charges are about 20 per cent higher and for such journals as *Angewandte Chemie* and *Die Chemische Fabrik* amount to 15 per cent of the total cost of publication Salaries and wages are estimated at 25-100 per cent above the 1913 level The size of editions is one of the most difficult problems confronting the publisher Profits can only be made on sales in excess of a certain minimum, and to promote sales by diminishing costs, endeavours have been made to issue new editions of textbooks every seven or eight years instead of three or four years, but there are limits to such efforts imposed by the rapidity of scientific developments Foreign sales have diminished enormously for political reasons as well as through increased competition, and for reasons similar to those operating internally Advertisement revenue has assisted considerably in the reduction of the price of certain journals of applied science, but only amounts to about one third of the revenue from this source in 1929 30 Retail and wholesale booksellers in Germany demand a 25-30 per cent discount as against 15 16⅔ per cent abroad, and the trade is overcrowded The reduction in the average price of German books from 8 36 to 4 32 gold marks in four years is largely due to the special cheap editions issued by the million, and is not reflected in scientific books, the purchasers of which have been heavily hit financially

Increased purchasing power, decreased taxation and costs of production with further efforts at condensation are the only hopeful means of increasing the circulation The American proposal to publish only the more important scientific papers, retaining the majority in manuscript and providing photostats as required, is severely criticised as fatal to publication of scientific knowledge and its effective circulation

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Copepods from West Greenland Waters*

AN important collection of pelagic copepods is described by Dr P. Jespersen from the waters west of Greenland in the Davis Strait and Baffin Bay, with one station to the south-west of Iceland The submarine ridge across the narrow part of the Davis Strait with a maximum depth of 700 metres forms an effective barrier to the migrations into Baffin Bay of many Atlantic species the habitat of which is deeper than this; the depths to the south of the ridge exceeding 3,500 metres and the depths in Baffin Bay amounting to at least 2,000 metres Warm Atlantic water predominates in the sea area south of the Davis Strait, but along the west coast of South Greenland the East Greenland polar current makes its way round Cape Farewell, and in the most western part of this area there are several stations, taken by the expedition, situated in the cold Labrador current A part of the Atlantic water passes over the submarine ridge in the Davis Strait and up into Baffin Bay, where it forms an intermediate layer below the surface with a positive temperature The bottom water of Baffin Bay has on the contrary a negative temperature of about − 0 4° The temperature conditions alone thus form a natural limit to the northward advance of certain species

The species are divided into two main groups those which are found in the whole area investigated and those which are exclusively, or to a predominant degree, found in the waters south of Davis Strait, 23 species being found in the first and 76 species in the second division. Davis Strait thus appears to form the northern limit of distribution for a large number of Atlantic species, and it is specially those found in fairly great depths that cease to penetrate northwards and those more frequently caught in the upper layers which occur in the whole area Most of the species are oceanic and no species were found which in a pronounced degree are restricted to the Arctic sea areas Indeed Dr Jespersen states that "it is certainly a question whether among the oceanic copepods there are any distinct arctic forms at all"

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* Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland Bd 79, Nr 10 The Godthaab Expedition 1928—Copepoda. By P Jespersen Pp 166 (København C A. Reitzels Forlag, 1934) 8.60 kr

The most frequent species were *Calanus finmarchicus*, *Calanus hyperboreus*, *Metridia longa* and young stages of the genus *Pareuchaeta* *Calanus finmarchicus* predominates in the hauls from the south of Davis Strait and the numbers are considerably reduced in Baffin Bay In Smith Sound, much farther north, it is again abundant in the surface layers *Calanus hyperboreus*, which likes cold water, is found only in small quantities south of Davis Strait, in the Strait itself in the upper layers being more abundant and in Baffin Bay present in small quantities *Metridia longa* occurs in small quantities south of the Davis Strait and in the upper layers of the Strait itself, but occurs in fairly large numbers in Baffin Bay. *Pareuchaeta* in its young stages is found in the water south of Davis Strait and only in small quantities in the Strait itself and in the more northern parts investigated.

Details of distribution and biology of all the species are given whenever possible with much interesting information, and many species are shown to have a more northerly distribution than was known before. A series of tables and curves is also provided One new species was found, *Euchaeta Wilsoni*, and this is represented by only one specimen

All-Metal Radio Receiving Valves

IT will be recalled that about two years ago the 'Catkin' series of receiving valves was first produced in Great Britain (see NATURE, **131**, 735; 1933) In the construction of this valve, the amount of glasswork was reduced to a considerable extent, the upper portion of the envelope being formed of the cylindrical copper anode, which was sealed to the lower glass portion by a vacuum-tight joint Now, an entirely new series of literally all metal receiving valves is announced by the General Electric Co of America, and brief details of these were given by the New York representative of the *Wireless World* in the issue of that journal of April 19 These new valves employ a cylindrical outer shell of steel or iron welded to a metal base which rigidly supports the electrode system The lead in wires from the electrodes are strung through beads of glass, which are then placed in eyelets of a new alloy known as Fernico, which lines the holes in the base of the valve The assembly is then passed through a gas flame which fuses the glass beads so that they fill the eyelets Fernico is an alloy of iron, nickel and cobalt which has the same coefficient of expansion as the beads of glass employed, so that the seal is accomplished without setting up strains in the fusing process After the electrode system has been attached to the leads, the metal outer shell is placed over the structure and welded to the base The valve is now exhausted through this metal tube, which is then clamped, welded and cut off at the appropriate time

The use of an all metal construction enables the valves to be made smaller in dimensions than existing glass valves, with corresponding reduction in lengths of leads and inter-electrode capacitances The valves may therefore be of higher amplification factors without instability, and should retain their efficiency at shorter wave-lengths than existing types Further, since the metal shell completely surrounds the valve and is maintained at earth potential, there will be no necessity for shielding the valve after it is placed in its socket in the receiver. At the present time, six types of all-metal valve have been put into production at the R C A Manufacturing Co, which will make the valves for the General Electric Co It is expected that new receivers designed round the metal valve will be produced by the autumn of this year

Physical Methods in the Study of Earth Structure

THE increasing specialisation of science and its literature inspires an ever-growing demand for expositions of separate branches in terms suitable for workers in other fields. The effort to prepare such accounts is often beneficial to those who provide as well as to those who hear or read them, but some stimulus for their provision is needful, and notable among the available effective stimuli are the endowed annual lectureships of such bodies as the Institution of Civil Engineers. This is well exemplified in the forty-first James Forrest Lecture, delivered to that Institution on May 7 by Prof O T Jones, who took geophysics as his subject

The choice by a geologist to lecture on geophysics might in past years have led to a passionate or scornful attack on the geological ignorance of geophysicists, but even in this age of tolerance, Prof Jones is notable among geologists for his sense of the importance of physical methods in studying the problems of the earth He has, in fact, produced an admirably clear account of the subject, after modestly disclaiming any rôle save that of the exponent. So calm is the 'atmosphere' of his address that the geophysicist may even feel a craving for at least some more distinctively geological criticism or flavour But in the closing part of the address Prof Jones made a most interesting reference to a British problem that is of interest alike to geologists, geophysicists and engineers.

In many parts of the British Isles, Prof Jones stated, there are known to be many deep rock channels that are so filled with various materials that their existence has not been suspected until engineering explorations for railways, roads, tunnels or sites for reservoirs have revealed them Some of them are known to be post-glacial. others, being filled with glacial drift, must be pre-glacial It is still uncertain whether these latter are due to normal river erosion, in which case their gradient must have been continuously downward to the sea-level of their period, or whether they have been excavated by streams flowing below the ice, in which case they may be deep narrow channels with a rising gradient both ends Several of these channels are known in East Anglia, one seems to commence a few miles south of Cambridge, and follows approximately the line of the L N E R to Bishop's Stortford at least as far as Newport It deepens rapidly southward, and if it is a normal river channel it must somewhere enter the sea, possibly following the Lea valley into the Thames estuary If so, it might cause grave difficulty to engineering projects (as other such channels have done elsewhere), like that for a Thames tunnel east of the Lea valley The buried channel of the Thames higher up is well known, but if the Newport channel does indeed enter the Thames estuary, its depth below sea-level would far exceed that of the known channel It would therefore be of great interest both to geologists and engineers if such channels could be detected with certainty by geophysical methods

The lecture briefly describes such applied geophysical methods, after discussing the scope of geophysics and the history and present position of the main 'pure' problems of geophysics It should be added that the term geophysics is used in the lecture in a restricted sense and such a remark as "geophysicists in this country do not concern themselves very much with the electric and magnetic field of the earth, which are observed in detail in various observatories", and the mention of the Carnegie Institution's Geophysical Laboratory without reference to the same Institution's great Department of Terrestrial Magnetism, must be interpreted as betokening unfamiliarity born of lack of personal interest in these further fields of geophysics

History of Bitumen

TO DAY, when petroleum with its vast range of derivatives is regarded as indispensable to the welfare of man, it is wholesome to be reminded of the salient factors which gradually extended its usefulness during the course of some five thousand years It is equally salutary to have delineated handicaps of lack of knowledge, apparatus and facilities, which nevertheless were minimised by the ingenuity of ancient peoples who employed bitumen for a variety of purposes still recognised to-day

A booklet entitled "The Story of Bitumen" (presumably by R J Forbes of Amsterdam, who last year contributed a similar article to the periodical *Bitumen* entitled "Aus der ältesten Geschichte des Bitumens") recently issued by Shell-Mex, Ltd., gives a brief account of the exploitation of bitumen from earliest records of its existence to about A D 1800 Abundant deposits were known even to the most ancient civilisations inhabiting the region between the Nile valley and that of the Indus, but production was necessarily confined to surface operations by lack of knowledge of the technique of deep drilling and absence of geological information on deeper oil or rock-asphalt deposits At the end of the period reviewed, in spite of vicissitudes which hindered rather than accelerated growth of the industry, particularly at the time of the later Roman Empire, the majority of deposits of which we now have knowledge were actually known Then, however, the importance of petroleum was negligible compared with present-day values, for the internal combustion engine which was later to give such tremendous impetus to the industry and create such a widespread demand for petroleum products was not yet discovered

Records of actual production in ancient times are naturally scanty It is obvious, however, that methods were extremely crude, as it is authentically reported that bitumen was recovered from the Dead Sea by men in rafts who simply 'hacked off' as large a piece of the floating mass as they could conveniently carry away Similarly, until the eleventh century, only the most primitive attempts towards distillation were made, and this fact virtually excluded the use of light combustible oils Gradually, however, more elaborate and practical methods were evolved, until at the beginning of the nineteenth century it may safely be said that the foundations of modern distillation technique were laid. Even so, no appreciable growth of the industry took place until after 1860, when deep drilling came within the realms of possibility It is surprising, therefore, that in spite of all these handicaps and difficulties to easy production, we find bitumen was used extensively in antiquity as a building and road material, as a waterproofing agent and in various guises as a weapon in times of warfare In comparatively recent times it was universally used also for lighting and heating purposes and as an ingredient of paints

The booklet, in addition to tracing the story of bitumen, gives a chronological list of outstanding dates in the history of bitumen and includes a bibliography on petroleum and bituminous materials which, together with the numerous excerpts from early works quoted in the text, should provide a useful background to a historical study of the petroleum industry

University and Educational Intelligence

BELFAST —Dr H Barcroft, lecturer in physiology at University College, London, has been appointed to the Dunville chair of physiology in succession to Prof T H Milroy, who is retiring on October 1 Dr D C Harrison, lecturer in biochemistry in the University of Sheffield, has been appointed to the J C White chair of biochemistry, in succession to the late Prof J H Milroy

Colonel S H Browne, formerly of the Indian Medical Service, has bequeathed to the University £10,000 to found medical research scholarships

CAMBRIDGE —The Royal College of Veterinary Surgeons has intimated to the Vice Chancellor that candidates who submit evidence that they are graduates in the Natural Sciences Tripos and that in the course of their examination they have passed in physiology, pathology, biochemistry and anatomy, may be exempted from the second examination conditionally on their passing the prescribed examination in animal management before the third examination

At St John's College, F. J S Hollick has been elected into a fellowship

OXFORD —The Halley Lecture will be delivered on June 5, at 5 p m in the Lecture Theatre at the University Museum by Dr J S Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B C., Canada, who will take as his subject "Dimensions and structure of the Galaxy"

Mr. J. N L Baker has been appointed University reader in historical geography for seven years from October 1 Miss B M Blackwood has been reappointed university demonstrator in ethnology for one year from October 1.

A reader in statistics is to be appointed for five years from the first day of Michaelmas Term, 1935, the warden and fellows of All Souls having undertaken to provide a stipend of £600 a year for that period.

In continuation of his course of lectures on the scientific contributions of members of the Oxford colleges, Dr R. T. Gunther, reader in the history of science, in a recent lecture directed special attention to the work of Robert Plot, John Radcliffe and Edmund Cartwright, all of University College, and respectively a great natural historian, a most munificent benefactor and an eminent inventor. At the same time the lecturer expressed his regret that the present Radcliffe Trustees should not have considered it their duty as managers of a charitable trust to preserve intact the historical scientific library of Prof. Stephen Rigaud, which they had purchased for far less money than it has now realised in a public sale-room.

UNEMPLOYMENT among young university graduates formed the subject of the deliberations of the Committee of International Students' Organisations at its meeting on April 10-11. As regards the possibilities of limiting the attendance of students at universities, the Committee urged that it would be both harmful and dangerous to endeavour to place restrictions on those who could rightly claim to attend the universities, and it disapproved of the imposition of a bar against women or against certain classes of the population on grounds of race or opinion. As a remedy for unemployment among intellectual workers, it recommended the establishment of university and professional information centres in the various countries, and suggested that public authorities or mutual aid societies should undertake the direction of certain branches of intellectual work for which private individuals have not the means to provide. Further, it suggested the adoption of measures by universities or student organisations for training young intellectual workers for their professions in country districts or colonies such as the 'social groups' in France, the 'educational missions' in Spain, or the 'frontier colleges' in Canada. Another recommendation was that bilateral or plurilateral agreements should be framed regarding the equivalence of university degrees, the exercise of professions abroad, and the employment of intellectual workers in foreign countries. The Committee urged international organisations of students and intellectual workers to consider the possibility of establishing an international organisation for securing work on the basis of the general information which might be supplied by the International Labour Office.

Science News a Century Ago

University of London

On May 18, 1835, *The Times* said, "Yesterday the annual distribution of the medals and prizes to the successful candidates in the medical and surgical departments took place at the London University; Lord Nugent presided on the occasion . . . Immediately after the distribution of the prizes the Chairman rose and addressed the company. His lordship had been about three years from London. At his departure the London University was in a state of infancy; at his return he had been highly gratified on finding that it had made so rapid a growth towards maturity. Mr. Thomas Campbell, who had first suggested the foundation of the present establishment, had said, that only two capital cities of Europe had been without universities, London and Constantinople. The reproach was now removed from London, in which two most useful institutions flourished, not in a spirit of opposition to each other, but in a spirit of laudable emulation and generous rivalry."

Progress of Mechanics' Institutions

At the anniversary meeting of the London Mechanics' Institution (now Birkbeck College) held on May 20, 1835, the president, Dr. Birkbeck, is reported to have said that "This establishment was still flourishing, and those elsewhere were becoming more numerous and more prosperous. The most remarkable circumstance connected with the prosperity of mechanics' institutions was the establishment of one at Cambridge, which had received the approbation and patronage of all the great and the wise of that distinguished seminary of learning. . . . Endeavours had been made to establish a mechanics' institution at a place near Bolton, but he (Dr. Birkbeck) had received a letter from the person who made the attempt, stating that the mean rate of wages was only 7*s.* a week, and although the subscription had been dropped from 10*s.* a year to 6*s.*, he could get no subscriptions, nor any donations. . . . At Manchester and Liverpool, however, the progress of these institutions had been great. . . . The number of members belonging to the metropolitan institution was 1,123, exclusive of honorary members; that of Manchester, including honorary members, was 1,232, and that of Liverpool including honorary members, was 1,206."

Theory of Respiration

At a meeting of the Royal Society on May 21, 1835, Dr. William Stevens read the concluding portion of his paper on observations on the theory of respiration. After reviewing the author's remarks on the interaction of the air and the blood and the experiments with which the paper was accompanied, the report in the Society's *Abstracts* said: "According to those views it is neither in the lungs, nor generally in the course of circulation, but only during its passage through the capillary system of vessels, that the blood undergoes the change from arterial to venous; a change consisting in the formation of carbonic acid, by the addition of particles of carbon derived from the solid textures of the body, and which had combined with the oxygen supplied by the arterial blood; and it is by this combination that heat is evolved, as well as a dark colour imparted to the blood. The author ascribes, however, the bright red colour of arterial blood, not to the action of oxygen which in itself is completely inert as a colouring agent, but to that of the saline ingredients naturally contained in healthy blood. On arrival at the lungs, the first change induced in the blood is effected by the oxygen of the atmospheric air, and consists of the removal of the carbonic acid, which had been the source of the dark colour of the venous blood; and the second consists in the attraction by the blood of a portion of the oxygen, which it absorbs from the air and which takes the place of the carbonic acid."

Societies and Academies

PARIS

Academy of Sciences, April 1 (*C R*, 200, 1161–1256) PAUL LANGEVIN: A suggested experiment of M Dufour This experiment was suggested as one capable of differentiating between classical kinematics and that of limited relativity A mathematical analysis shows that, in the form laid down by M Dufour, the experiment would fail to detect any difference A modification is suggested by the author, which is theoretically capable of detecting the difference, but in practice it cannot be carried out ERNEST ESCLANGON Experimental researches on the optical dissymmetry of space JULES HAAG The algebraic structure of the admittances of a filter as a function of the frequency FLORIN VASILESCO The continuity of the potential through masses and the demonstration of a lemma of Kellogg GHERMANESCO Exceptional homogeneous combinations of integral functions ANDRÉ FORTIER The kinematics of flow round profiles with hyper sustaining arrangements ADRIEN FOCH and CHARLES CHARTIER The flow of a fluid below a sphere PIERRE LEJAY and TSANG HUNG CHI Observations of the intensity of gravity at the centre of China Table of results from sixty-five stations, showing the reduced values of g and the corresponding anomalies LUCIEN BULL A liquid string galvanometer A modification of the string galvanometer, using a thread of water of 0 3 mm diameter CH LAVANCHY General method of calculation for electrical networks PIERRE GIRARD and PAUL ABADIE The detection of molecular interactions by the relaxation time of polar molecules. ANDRÉ CHARRIOU and MLLE S. VALETTE The influence of the cations on photographic emulsions MLLE CÉCILE STORA The action of gases (hydrogen, nitrogen, oxygen) on photo-cells with colouring matters MLLE YVETTE CAUCHOIS Study of the *L* spectrum of mercury C G BEDREAG The place of protons and neutrons in the natural systematics of the elements B KURTCHATOV, J. KURTCHATOV and G LATYCHEV The disintegration of boron by slow neutrons The vapour of methyl borate was acted upon by slow neutrons and the effects followed by the Wilson method The photographs show that the disintegration was accompanied by the emission of two heavy particles and not three as found by Chadwick and Goldhaber B KOURTCHATOW, I KOURTCHATOW, L MYSSOWSKY and L ROUSSINOW An example of artificial radioactivity, produced by bombardment with neutrons, without capture of the neutron GEORGES WOLF Study of the binary system strontium nitrate – strontium hydroxide E RINCK Solidification diagrams of the alloys formed by two alkali metals, the potassium rubidium alloys FRANÇOIS PUCHE: The thermal decomposition of the chloride and chlorosalts of palladium MAURICE CHAIX: The ultra-violet absorption spectra of derivatives of diphenylene sulphide and diphenylene-sulphone HENRI GUÉRIN. The reduction of the arsenates of the alkaline earths by carbon Tricalcium and tristrontium arsenates GUY GIRE The formation of basic sulphate and the precipitation of nickel in solution by magnesium. PIERRE CARRÉ and DAVID LIBERMANN: The reaction of thionyl chloride and phenylglycollic acid M. TIFFENEAU and P. WEILL: The hydrobenzoin dehydration of phenylethenylglycol. The formation of α-phenylcrotonic aldehyde VICTOR HARLAY Some silver compounds of thiosemicarbazide and of the thiosemicarbazones FRANÇOIS SALMON-LAGAGNEUR. Some reactions of the chloride of the α-mononitrile of camphoric acid ISSAC KOGA and MITSUO SHOYAMA The frequency-temperature characteristics of quartz plates oscillating with zero temperature coefficient J FRANC DE FERRIÈRE The history of the loess soils of the Rhenish terraces in Haute-Alsace LOUIS and HENRI LONGCHAMBON The extension of the Toarcian hydrocarbon facies in the east of France CH COMBIER The constitution of the sand winds in Syria ROBERT GIBRAT and GEORGES VIEL The relation between the electrical conductivities of the air and the danger arising from lightning R GUIZONNIER The amplitude of the semidiurnal component of the gradient of terrestrial electric potential and solar activity MME C SOSA-BOURDOUIL. Physiological researches on the parents and hybrids of the bean, *Vicia Faba* MAURICE MARIE JANOT The action of folliculine and equilenine on the development of the hyacinth JOSEPH and CHARLES BOUGET Cultures of tubers obtained by the germination of seeds of potato raised in the mountains in 1933 ROBERT ECHEVIN The absorbing power of soils towards magnesium chloride LOUIS MAUME and JACQUES DULAC The C/N ratio in the wheat plant at heading and flowering its marked variations with the medium JAMES BASSET, EUGÈNE WOLLMAN, MICHEL A MACHEBŒUF and MICHEL BARDACH The biological effects of ultra pressures the action of high pressures upon tumours MLLE HENRIETTE GARRAULT The formation of rods of elastoidine in embryos of Salmonidæ. P LECOMTE DU NOÜY and MLLE VIVIANE HAMON A new method of estimating the diphtheria antitoxin by the viscosity. RENÉ LEGROUX and ANDRÉ LWOFF The schizogonic evolution of the macrogametocyte of *Hæmoproteus paddæ* FRÉDÉRIC DIÉNERT Study of the clarification of water by micro-organisms PAUL GIROUD and HARRY PLOTZ Crossed immunity between cultures of historic exanthematic typhus (murin) and the virus of passage

CRACOW

Polish Academy of Science and Letters, March 4 M. WOLFKE The effective section of the neutrino Starting with the measurements of Chadwick and Lea, and taking account of the ionisation by the secondary electrons, the free path of the neutrino in normal air is about four million kilometres, corresponding to an upper limit of the effective section of the neutrino of about 7×10^{-33} cm^2 MLLE. S SZAFRANSKA. The viscosity of mixtures of hexane and nitrobenzene in the neighbourhood of the critical temperature of solution. The isothermal lines of the viscosity of mixtures are quite regular in the region not showing the phenomenon of opalescence This is not in agreement with the results obtained by Drapier and it is suggested that these irregularities were due to Reynolds's condition not being fulfilled B KAMIENSKI · A method of measuring the dielectric potentials at the surface of separation of the phases solution · air A dynamical method is employed, the solutions flowing concentrically together Owing to the surfaces being continually renewed, the results are more constant than those obtained by the static method. L MARCHLEWSKI and J SKULMOWSKI The absorption of ultra-violet rays by certain organic substances (38) L. MARCHLEWSKI and W URBANCZYK: Studies of some chlorophyll derivatives

M Ksiazkiewicz. Zone of the Carpathian klippes in the neighbourhood of Andrychow (2) The klippes of Panska Góra and of Targanice W Szafer The forest and steppe of the western part of Podolie A. Bursa: List of the Algæ collected in the waters of the Polish shore of the Baltic Mlle M Skalinska Cytogenetic studies on a tetraploid hybrid of *Aquilegia* T Sulma. Remarks on the ecology and distribution of the lichens in the Lublin plateau. Mlle J Woloszynska Some remarks on *Attheya decora*, a very rare planckton diatom Mlle J Woloszynska The efflorescence of the Cyanophyceæ in the gulf of Gdansk, and the abundant development of the diatom *Chaetoceros Eibenii*

Leningrad

Academy of Sciences (*C R*, 1, No 4, 1935) N Romanov The possibility of connecting the Pavlov theory of conditioned reflexes with the theory of probabilities I Privalov Some problems of the theory of subharmonic functions (1) L Kantorovitch Continuation of linear functionals K Nikolskij Relation between the field equations of Born Infeld and Dirac's quantum equation E Gross and M Vuks The Raman spectrum of amorphous bodies L Groshev The crystal photo effect in naturally coloured rock salt K Andrejev The burning of explosives S Nametkin and N Melnikov Contribution to the chemistry of organic compounds of thallium J Ellenhorn, A Prokofjeva and H J Muller Optical resolution of chromosomes of *Drosophila* by means of ultra-violet light P Terentjev Contribution to the problem of the real significance of the Pearson type of distribution curves in the case of biological objects E Wermel and M Mickevich Influence of hormones on the growth of tissue cultures A Lindberg Influence of caffein on the activity of the outer layer of the cerebral hemispheres S Kaganovskaya and A. Shlykova Influence of potassium chloride and calcium chloride on the respiratory metabolism of nerves. L Yakubova The biogeographic division of the Black Sea on the basis of composition and distribution of its benthos fauna S Taranetz and A Andriashev A new fish of the family Zoarcidae from the littoral fauna of the Commanders' Islands

Vienna

Academy of Sciences, March 7 Jovan Jurišić Morphology and teratology of the blooms, and propagation, of *Bryophyllum crenatum*, Baker Karl Przibram. Fluorescence of fluorite (5) Fluorescence of europium dichloride, and alkali halide europium phosphors Pure europium dichloride shows a bright purple fluorescence, the spectrum exhibits the blue fluorite bands and, in the red, a narrow line-like band at 690 mμ and a paler one at 630 mμ, corresponding with that given by fluorites As previously supposed, the blue bands of fluorite are those of bivalent europium, and the same is probably the case for the red bands Europium may be rendered capable of fluorescence by incorporation in alkali halides, and then shows, after radium irradiation or heating, the red and blue bands; the latter serve as a sensitive indicator for europium. G. Natta, M Baccaredda and R Rigamonti Electron diffraction as an aid to the determination of the structure of organic substances. Kurt Ehrenberg: Comparative studies of juvenile skulls and milk-teeth of the cave hyena and its recent relatives.

Forthcoming Events

[Meetings marked with an asterisk are open to the public]

Sunday, May 19

British Museum (Natural History), at 3 and 4 30 — M A Phillips "Fossil Reptiles" *

Monday, May 20

Royal Geographical Society, at 5 —J Wright "The Hagavatn Gorge, Iceland"

National Institute of Industrial Psychology, at 5 30 (London School of Hygiene and Tropical Medicine, Keppel Street, W C 1) —Prof Major Greenwood "Temperaments Physical and Psychological in Modern Science" *

Thursday, May 23

Royal Society, at 4 30 —Prof J Barcroft "Foetal Respiration" (Croonian Lecture)

St Mary's Hospital, London, at 5 —Dr C H Andrewes "The Cancer Problem Some Fresh Clues" *

Chadwick Public Lecture, at 5 30 – (in Manson House, 26 Portland Place, W 1) —Miss Noel Tidy "Physical Exercises Educational and Preventive".*

Chemical Society, at 8 – Prof J E Coates Haber Memorial Lecture

Official Publications Received

Great Britain and Ireland

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1621 (S 178) Cine-Photographic Measurements of Speed and Attitude of Southampton Aircraft when Taking Off and Alighting By A E Woodward Nutt and Dr G J Richards Pp 13+7 plates 1*s* net No 1623 (T 3488) Effect of Discs on the Air Forces on a Rotating Cylinder By Dr A Thom Pp 10+7 plates 9*d* net No 1626 (T 3534) Interference Effect of Surface of Sea on a Flying Boat By W L Cowley and G A McMillan Pp 15+8 plates 1*s* net No 1627 (T 3586) Tests of Six Aerofoil Sections at Various Reynolds Numbers in the Compressed Air Tunnel By E F Relf, Dr R Jones and A H Bell Pp 28+6 plates 1*s* 6*d* net (London H M Stationery Office)

Other Countries

Merentutkimuslaitoksen Julkaisu Havsforskningsinstitutets Skrift No 98 The Thalassological Summer Cruise in 1934 By E Palmén Pp 17 No 99 Vedenkorkeusarvoja 1933 (Vattenståndsuppgifter 1933) By S E Stenij Pp 52 No 100 Regular Observations of Temperature and Salinity in the Seas around Finland, July 1933–June 1934 By Gunnar Granquist Pp 45 (Helsinki Merentutkimuslaitos Havsforskningsinstitutet)

Proceedings of the California Academy of Sciences, Fourth Series Vol 21, No 20 The Templeton Crocker Expedition of the California Academy of Sciences, 1932 No 20 The Termites By S F Light Pp 233–256+plates 9–10 No 21 The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933 No 21 Some Marine Plants of Southeastern Melanesia By William Albert Setchell. Pp 259–270+plates 11–15 (San Francisco California Academy of Sciences)

Zoologica Vol 19, No 1 The Distribution of Certain Whales as shown by Logbook Records of American Whaleships By Charles Haskins Townsend Pp 50+4 plates Vol 19, No 2 The Vampire Bat, a Presentation of Undescribed Habits and Review of its History By Raymond L Ditmars and Arthur M Greenhall Pp 53–76+plates 5–7 (New York New York Zoological Society)

U S Department of Commerce National Bureau of Standards Research Paper RP 756 A Maxwell Triangle yielding Uniform Chromaticity Scales By Deane B Judd Pp 41–67 (Washington, D C Government Printing Office) 5 cents

Ceylon Sessional Paper 4—1935 Report and Accounts of the Coconut Research Scheme for 1934 Pp. 11. (Colombo Government Record Office) 15 cents

Catalogues

A Catalogue of Rare and Interesting Books, XVIIth and XVIIIth Centuries and onwards (No 474) Pp 36 (Cambridge. Bowes and Bowes)

General Catalogue of Books, with a selection of Atlases and Maps. (No 585) Pp. 98 (London Francis Edwards, Ltd)

Catalog and Price List of Eastman Organic Chemicals Twenty-sixth edition 112 (Rochester, N Y.: Eastman Kodak Co.)

The Salermo Process and the Extraction of Oil from Oil Shales and Torbanites Pp. 24 (London. Salermo, Ltd.)

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Art in Modern Industry

THE attention which has been given in recent months to industrial design and the relations between art and industry has an important bearing on other profound problems of the machine age In spite of their efforts to foster healthier relations between creative design and craftsmanship, Ruskin and his school must take a large share of responsibility for the belief that a machine could not produce a thing of beauty While explaining that the wisdom of art consists in its unselfish devotion to the service of man, while insisting on the necessity for providing elements of beauty in the surroundings of the workman, and that art does its duty "in completing the comforts and refining the pleasures of daily occurrence and familiar service", Ruskin brought a somewhat rigid conservatism to bear on the use of new materials in art, particularly the use of metals

This attitude to the products of mechanical industry is rapidly passing, and even the most fleeting visit to such an exhibition as the British Industries Fair reveals the extent to which methods of mass production are now providing us with things of intrinsic beauty alike in plastics, textiles and many other fields Particularly is this to be observed in relation to the new constructional materials with which science is providing the building industry, the significance and utility of which are only now beginning to be realised by the public

These new materials are now finding expression in new forms adapted to their own inherent qualities and the specific and sometimes novel needs of the community to-day They are not being impressed rigidly into those forms in which craftsmanship of the past expressed the beauty and utility of older materials The significance of this point can scarcely be over-stated In fact, Ruskin's objection to the use of iron in architecture was to the use of iron in the way in which stone had been used in the past, rather than to its use in new ways adapted for the expression of its own valuable qualities It would be difficult to adduce from his writings objections which could be validly advanced against the form which the use of steel in structural work is taking to-day.

We are, in fact, witnessing to-day the escape of industrial design from the fetters of the past, and an impetus is being given to the creative instincts the full effect of which is far from being felt. The manufacturer is now concerned less with imitating the past than with discovering new methods of artistic expression for the new powers and materials. Industrial design has acquired a new significance, none the less important because it permits the production of beautiful and artistic objects by the thousand or ten thousand where the old individual craftsman could turn out only units or at most dozens. It affords an opportunity of expression to these creative instincts of man which is akin to the opportunity afforded in the scientific researches that have provided industry with the new materials upon which such design is executed.

The reaction of science upon industry thus itself ensures that industrial art shall be dynamic. Design is influenced as much by the materials and methods at its disposal as by taste and education, and failure to respond to the resources in the way of new materials placed at its disposal by the development or adaptation of technique, can be as disastrous as failure to respond to æsthetic considerations, or lack of sympathy with the spirit of the age in which the designer or craftsman works.

Industrial design is thus more than the application of art to a product in accordance with the inclination of an artist. It goes deeper than the sketching of graceful lines and masses. The industrial designer must understand the desires and fancies of the public, whether as a result of careful surveys or constant familiarity with the qualities in an article which promote sales. He must not only be familiar with the relative advantages and disadvantages of the similar and competitive articles on the market but also understand something of the possibilities and limitations of the factory where the article is manufactured. For him the skilful selection which constitutes art depends as much on research as the manufacturing processes resulting in the article to which the designer's art is applied.

Under modern conditions, therefore, the task of the industrial designer has become ever more complex, and indeed almost insoluble except when he works in close alliance with the scientific worker as well as the artist. Only from science can he acquire full understanding of the properties of the materials of industry and the processes by which they are worked; for upon this knowledge alone can be based a technique and resourcefulness in design capable of giving full expression to the possibilities of the materials or the highest satisfaction to man's artistic and æsthetic requirements. The note of service is as dominant in art as in science and is indeed one of their strongest links.

The improvement of industrial design and the development of closer relations between art and industry do not depend upon the manufacturer's efforts alone. Many of the industries concerned are traditional and dominated by the outlook and spirit of craftsmanship, with all its inherent advantages and defects. In such industries, side by side with the scientific worker's task of determining, by tactful and harmonious co-operation, the basic principles underlying traditional practice, sometimes of centuries standing, there is the task of assisting the craftsman to adapt himself to changed materials and changed conditions. The very strictness with which in the past the members of a craft have guarded their organisation, no matter how high their ideals of service or individual efficiency, has discouraged receptivity of new ideas and adaptation to new conditions.

This position is the more serious when—as to-day—under the influence of science, new materials and new techniques are being created which are outside the traditional experience of the craftsman and for which that experience affords little or no guidance. The essential task is thus one of education—of assisting the craftsman or designer to acquire the knowledge which will enable him to cope with the new conditions and use the new materials, while safeguarding the individual instincts and ideals of craftsmanship which inspire the finest work. In certain industries, such as building and decorating and the paint industry, such educational work is urgently required. Increased facilities in connexion with the teaching organisations with which such crafts are already equipped, for the systematic demonstration, examination and handling under practical conditions of the new materials now available, are highly desirable if the average craftsman is to be kept abreast of current scientific developments in industry affecting his occupation.

Developments along these lines should be of advantage to the manufacturers of the newer materials, as well as to those who use them and the public for whom the craftsman works. The lack of personal knowledge of the average painter or builder, for example, of many of the new pigments, oils, resins, diluents, plastics, etc., not merely hinders the artistic use and development of the new products, but also prevents the craftsman adopting the critical and independent attitude that he adopts to the old and more familiar materials of his craft Only slowly can he acquire the practical knowledge which at once frees him from dependence on manufacturers' recommendations and then permits the skilful selection which is the essence of art

To some extent no doubt, developments in the training of those entering traditional industries or occupations may lead to a more scientific outlook and to greater receptivity to new ideas With the present rate of industrial change and development, however, the need for practical experience of the new materials upon which we have touched will persist The craftsman cannot work with new materials without experience of them, however ready he may be to adopt them in his work, and however much we may do to improve the facilities for the collection and dissemination of modern technical knowledge, or the scientific and technical side of the training of the recruits for such occupations, it is only with the co-operation of the producers of the new materials that the qualified craftsman can acquire the experience which enables him to transmute them into the forms most adapted for everyday service in designs satisfying man's artistic as well as his material demands

The question of utilising for the widest purposes of society the qualities and advantages of the new materials with which advancing technical and scientific knowledge has endowed mankind is thus not to be solved by the efforts of one class of workers alone It demands the skill of the craftsman and artist, the technique and method of the scientific worker, whether in academic or in industrial work, the patience and inspiration of the teacher and the appreciation of the public for beautiful and serviceable things Only as these are in harmony can the finest results be achieved, and in each there must be not the wanton discarding of that which is old but the skilful discernment between the old and new, based on definite knowledge which can select the most appropriate material or method for the purpose In all this there is no room for blind prejudice The frank acceptance of change, and the willingness to face all it means, are no less the secret of the development of new industrial art than they are of mankind's capacity to evolve a new order of society competent to handle the dangers and difficulties of the present age

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Reviews

Himalayan Geography and Geology

A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet By Col S G. Burrard and H H Hayden. Revised by Colonel Sir Sidney Burrard and Dr. A M Heron Pp x+359+xxxii+65 plates (Delhi · Manager of Publications, 1933.) 28 rupees, 43*s* 6*d*.

THE original edition of this work, which appeared in 1908, was intended to mark the centenary of the first expedition sent to the Himalaya by the Survey of India for geographical purposes, having for its immediate object the exploration of the source of the Ganges. After just a quarter of a century, a second edition has been brought out. During these twenty-five years a great deal of detailed exploration of the region has been accomplished and much new ground has been broken

The book is divided into four parts dealing with (1) the high peaks of Asia, (2) the principal mountain ranges of Asia, (3) the rivers of the Himalaya and Tibet and (4) the geology of the Himalaya.

When the high peaks are classified, it is found that of those the heights and positions of which have been determined by the Survey of India, there are no less than 135 more than 20,000 feet high There is an interesting discussion on the errors of the adopted value of the heights of peaks. In the case of high mountains it has not been possible to observe reciprocal angles, that is, observations cannot be made from the peak itself on account of the physical difficulty involved in transporting instruments to the top On this account we have to depend for accurate results on the assumption of a correct coefficient of refraction, since refraction, among other sources—for example, the deviation of gravity—is liable to produce the greatest error An interesting detailed analysis is given of the height of Mount Everest and other high summits as obtained from the several stations of observation, the object being to show the degree of uncertainty attached to heights of great mountains by the limitations imposed on the surveyor Since the first edition a great advance has been made in our knowledge of the effects of atmospheric refraction, due to the investigations of Dr de Graaff Hunter, who has worked out a value for the coefficient dependent on height, temperature and pressure. Tables for use with this method are found in "Auxiliary Tables of the Survey of India", Part iii.

How a region, once undoubtedly under the sea, is now occupied by great mountain ranges, still remains without a satisfactory explanation. The elevation of the Himalayan Mountains appears to be due to the folding of the earth's crust, under the influence of a tangential force acting from the north, raising the floor of the Tethys sea which covered this area in past geological times. This folding was accompanied by the welling-up of granite and gneiss from the interior which now forms the main core of the great ranges. Concurrent with elevation, erosion was at work producing the complicated and confused masses we see to-day. The most potent cause of mountain building may have been the contraction of the earth's core, and the consequent wrinkling of the crust in attempting to accommodate itself to a smaller interior. However, to every theory which has been propounded objections have been raised on the ground of inadequacy of any known cause. The tectonic action is probably going on still, as evidenced by frequent earthquakes.

It is of interest to note that the conspicuous light brown band of rock at the base of the final pyramid, so well known from the pictures of the Mount Everest expedition, is not a sill of granite but is really calcareous sandstone. The final pyramid is composed of dark calc-schist.

The great rivers of the Himalaya present also a difficult problem. There is scarcely a mountain range in Asia that has not been cut across by a river. Nearly all the rivers rise behind, that is to the north of, the ranges, which they cut through more or less at right angles on their way to the plains of India. A remarkable feature is that when a river breaks from a trough, the range which is pierced is generally the higher of the two, also the gorge where the break through takes place is often situated near the highest point in the neighbourhood. Probably more than one cause has been at work to produce these remarkable results. One can imagine the rivers as serving the primeval drainage when the floor of the Tethys sea first emerged as dry land. When subsequent wrinkling of the crust took place the rivers were able by erosion to maintain their courses, modified, no doubt, by the inequalities of elevation and the necessity for having to seek lines of least resistance.

Part iv is devoted to the geology of the Himalaya and is from the pen of the late Sir Henry Hayden of the Geological Survey of India. We have only space to mention one point of interest to which attention is directed. That is the "main boundary fault". It extends the whole length of the Himalaya from Jammu State to Assam. It is a reversed fault along which the older rocks have been thrust over the younger. It has particular practical significance as it is in its proximity that at least three serious earthquakes have occurred within the last forty years, the most recent being the Bihar earthquake of January 1934. This seems to show that the thrusting and folding forces are still at work. Where, for any reason, resistance is offered to this action, building up occurs of stress conditions, which eventually cause a breakdown of the material with a resulting earthquake.

One of the original authors, Sir Sidney Burrard, has taken part in the revision, but the other, Sir Henry Hayden, was unfortunately killed on the Alps by a rock-fall in 1923. His place has been taken by Dr. A. M. Heron, of the Geological Survey of India.

All who are interested in the Himalaya, or contemplate travelling there, will find this work indispensable as a book of reference. No other publication treats of the region from the same points of view. The treatise is profusely illustrated by maps and diagrams. H. L. C.

Mathematics and Logic

(1) *A System of Logistic.* By Dr. Willard Van Orman Quine. Pp. xi+204. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1934.) 20*s.* net.

(2) *The Nature of Mathematics: a Critical Survey.* By Max Black. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xiv+219. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1933.) 10*s.* 6*d.* net.

(3) *Idealistic Logic: a Study of its Aim, Method and Achievement.* By C. R. Morris. Pp. ix+338. (London: Macmillan and Co., Ltd., 1933.) 12*s.* 6*d.* net.

THE number of those who still believe in a perfect continuity between logic and mathematics does not appear to increase to any appreciable extent. Gone are the heroic days when Russell's aphorism to the effect that "Logic is the youth of Mathematics, and Mathematics is the manhood of Logic" was reverently admitted to be a proved belief. The dazzling complexity and austere beauty of the "Principia Mathematica", a perennial masterpiece of which British thought has every right to be proud, caused people to hesitate taking up Russell's challenge "to indicate at what point in the successive definitions and deductions of *Principia Mathematica* they consider that Logic ends and

Mathematics begins" A casual visit to any public or college library would show conclusively that persistent thumb-marks can scarcely be found beyond Part 1 of the first volume of the "Principia" faith leaves the "Prolegomena to Cardinal Arithmetic" and the last two volumes of that monumental work shrouded in their virginal brilliance What is more, authors of textbooks of logic have asserted that negation and disjunction are the basic operations proposed in the second edition of the "Principia" they had failed to realise that there is an "Introduction to the Second Edition" in which Russell and Whitehead adopt as primitive in the propositional calculus the single notion of 'incompatibility', and direct the reader to replace their original theory of generalised deduction by an important chapter given in an appendix at the end of the volume and based entirely on the stroke notation

Logicians, however, remembered that authority is not always a sound foundation for argument With patience and ingenuity, they tried to verify the footsteps of the masters Soon enough, blemishes which were invisible to the inexperienced were revealed in the structure of "Principia" and diligently discussed by the experts. For example, F P Ramsey tried to dispense with the non formal Axiom of Reducibility by using functions defined in terms of truth-values with a minimum of specific reference to symbols L Wittgenstein's criticisms, on the other hand, may have led to some improvements in the exposition of the logistic thesis, but they really constituted a repudiation of its main tenet that logic can be *deduced* from mathematics L Chwistek has also tried to bring the unruly Axiom of Reducibility back to the fold, without winning, however, the unreserved approbation of the authors of "Principia" H M Sheffer, H Weyl and J Nicod, among others, have also suggested improvements , but these can scarcely be taken as adding an ounce of proof to the main contention of the logistic thesis

(1) A new line of approach is taken by Van Quine in his "System of Logistic" through which he proposes to remedy some technical difficulty of the "Principia". He finds that the system of the "Principia" depends not only on the primitive notions of incompatibility and universal quantification, but also upon a series of operations of predication and abstraction , and furthermore, that the explicit postulates and formal rules of the "Principia" must be supplemented by one series or another of informal rules governing substitution upon function variables. To mend this situation Van Quine proposes a system in which propositions are constructed as sequences of a sort ; quantification and the various devices of the propositional calculus are developed in terms of classes, and propositional functions are entirely eliminated from the new system, their duties being taken over by class variables This clean sweep of one of the major technical complications of the "Principia" is made possible by the adoption of certain new basic notions adequately expressed in an improved symbolism

The fundamental notion from which the new system starts is that of 'ordination', which includes the traditional subject—predicate doctrine—as one of its particular exemplifications For example, the proposition predicating whiteness of this paper is simply the sequence (whiteness, this paper), the comma being used as the new symbol for ordination When propositions are construed as sequences, identity between propositions becomes merely a case of identity between sequences , and these are identical only when their respective affixes are identical and their respective bases are identical

The two other primitive ideas of the system are 'congeneration', expressed by *placing the sign of* the operand in square brackets '$[x]$' , and 'abstraction' expressed notationally in the form '$\hat{x}\ y$' The first operation always refers to a class x and indicates that its result is of next higher type than the operand x The second operation affects a variable x, which is placed under the circumflex, followed by a propositional expression A set of 'rules of inference', definitions and six postulates helps to manipulate these primitive notions and to derive new theorems According to this symbolism, for example, the familiar notation of material implication is replaced by $[\hat{x}\ p]$, $\hat{y}\ q$, and the definition of number 1 is symbolised as the class of all unit classes of sequences

The higher generality of this new system is proved by its author through the deducibility of the system of the "Principia" The novelty of the alleged deduction consists less in the reduction of the formal postulates of the system, than in its assimilation of the Axiom of Reducibility as a 'trivial' theorem This part of the deduction as well as those dealing with descriptions and with unity are probably those which will be submitted to a closer scrutiny prior to their integration into a wider philosophical doctrine involving an appreciation of the relation of the new system of logistic to intuition and to the development of mathematics At this stage, however, Van Quine wisely avoids discussing the relationship of logic and metaphysics But if, as Prof Whitehead says, "Logic prescribes the shapes of metaphysical thought", such a discussion will not be long in taking shape. In the meantime we have little hesitation in sharing the belief expressed in Prof Whitehead's preface, that Van Quine's book constitutes a landmark in the history of the subject

(2) Among the many logicians who have devoted their labours to a patient analysis of the "Principia", Max Black has produced an excellent monograph in which he lays bare some fundamental deficiencies of the logistic method, and in which he proposes some suggestions for a reconstruction of the "Principia". He objects to the logistic definition of natural number, shows that Dedekind's definition of a real number is based on intuition, and denies that the logistic treatment of infinity and the continuum clarifies these notions. The difficulties begin with the calculus of propositional functions, interpreted in extension, where many more primitive notions are actually used than are enumerated in the "Principia" The derivation of mathematical functions from propositional functions and descriptions involving the use of 'incomplete symbols' is not at all satisfactory circularity and inconsistency lurk in the background, while the definition of identity, the true nature of incomplete symbols, the status of classes and the intuitions implied in the notions of infinity and continuity, involve non-formal elements which should not be integrated in a rigidly deductive system All these points are forcibly brought home, though Max Black's discussions are often sketchy, and fundamental criticisms are indicated rather than developed

The line of reconstruction suggested by Max Black is based on the necessity of working out an intensional interpretation of propositional functions, and on the initial distinction between the philosophic and the systematic aspects of the logistic system Its technical achievements can be saved by an elaborate reconstruction of its symbolism, by an analysis of the conditions of its significance or by sacrificing its original ambitions After all, similarities between logic and mathematics spring from the fact that logic, in its philosophical aspect, is the syntax of possible states of affairs, while mathematics is the syntax of all organised systems. The relation between mathematics and logic is therefore neither identity nor that of conclusions to premises This view, on the other hand, is strengthened by the pronouncements of the formalist and the intuitionist schools of thought, of which Max Black gives a short but excellent exposition

(3) If the Russellian tradition of logic thus fails to give a formal account of mathematics, so does also the idealistic logic, of which C R Morris supplies a critical survey of its development from Kant to Bradley The two types of logic are widely different · the first claims to be independent of psychology and metaphysics and to restrict its inquiry to the study of the possible inferential relations between propositions, while the second tries to bind thought with experience and to give thus an ordered and necessary account of reality as a whole Roughly speaking, the latter tradition seems to have a wider following at Oxford, while the former has Cambridge for its stronghold They both set out in their course with the conviction that Aristotelian logic is inadequate and that empirical psychology cannot produce an adequate theory of thinking Their reasons for this conviction are, however, different, and while the main grudge of symbolic logic against Aristotelianism is that its analysis of the various forms of propositions and deductions is too restricted and incomplete, the indictment of idealism against traditional logic is that it fails on the whole to explain modern science

Idealistic logic holds that thinking is a discursive operation, so that a judgment is never final, since it is always modified and corrected by a developing system of judgments. Thinking is, moreover, qualified by the mind, which is spontaneously creating a systematic unity. Consequently, C R Morris is at great pains to show that idealistic logic does determine *a priori* the character of experience through an analysis of the forms of thought Yet it is difficult to see how he can claim for it any other result than a legitimate defence of science and the possibility of knowledge against scepticism In particular, if he can show that all statements in the empirical sciences are perfectible by the developing system of judgments, he does not prove that this is also the case for mathematics In other words, the absoluteness of mathematical propositions cannot be explained by the general method of idealistic logic involving an interconnected series of progressive levels of reality, as they cannot be reduced to corrigible judgments The best argument C R. Morris finds, though fully aware of its limitations, in favour of an idealistic account of mathematics is as follows In other spheres thought proceeds by producing systems, certainly in mathematics the statements are the work of an active function of the mind, we may take it that it is the essence of thinking to be systematic here also, a mind which is elsewhere active in the acquisition of knowledge can scarcely, here and there in the course of its experience, be wholly passive, at least in the gaining of knowledge

This, however, is only a pious hope ; for we are still left with the unexplained difficulty that in mathematics the actual system-building itself seems to be without empirical taint, while elsewhere it is not C. R. Morris thinks that idealistic logic came to gloss over this difficulty largely because of its emphasis on instances taken from physics which, owing to its overwhelming use of mathematics, is a misleading case He has to confess also that the special nature of mathematical reasoning has to be left reluctantly as an outstanding, unsolved difficulty We believe, nevertheless, that it is in the light of higher principles and beliefs that mathematics finds its value and ultimate purpose THOMAS GREENWOOD

The Natural Sugars

The Carbohydrates By Dr E F Armstrong and K F Armstrong (Monographs on Biochemistry) Fifth edition Pp vii+252 (London, New York and Toronto Longmans, Green and Co , Ltd , 1934) 15s. net

WITH *the publication of the volume under* review, the revision of "The Simple Carbohydrates and the Glucosides" is completed In the present fifth edition of this well-known work, the original material has been divided into two volumes, one of which, "The Glycosides", was published in 1931 and reviewed in these columns in that same year More fundamental aspects of sugar chemistry are now dealt with in "The Carbohydrates" In the preparation of both parts of this edition, Dr. E F Armstrong has had the collaboration of his son—Mr K F Armstrong—whose recent lamentable death in the Tyrol has cut short a career of great promise We take here this opportunity of offering to his distinguished father and grandfather an all too inadequate expression of our deepest sympathy

"The Carbohydrates" deals only with the natural sugars and their derivatives; but even with this restriction the field is obviously a wide one, even when, as the authors state in their preface, "we have . restricted as much as possible the discussion of intricate structural problems" The reviewer is possibly unduly attracted by these same structural problems , and possibly it is this that leads him to regret somewhat the absence of a fuller historical account of the development of the important structural conceptions introduced by the first-suggested pyranose (amylene-oxidic) structures advanced in 1923 for xylose and galactose. In view, too, of the prominent part played by the open-chain aldehyde formula in the earlier developments of carbohydrate structure, some more extensive data might have been included concerning the authentic pentamethyl aldehydic hexoses and similar compounds now known These may, however, be judged minor points Within the 250 pages of "The Carbohydrates" and within the limits already mentioned, there is presented a very well-balanced survey of the present position of the sugar group

During the decade which has elapsed since the appearance of the fourth edition the advances then foreshadowed have become co-ordinated, and the appearance of the new edition is well-timed Obviously much had to be omitted and the authors have selected well, and in the wide field afforded by the sugars selection is not an easy matter To quote again the authors' preface, "the sugars have attracted workers of every nationality Emil Fischer would have been well pleased to see that there had been no loss of interest in his favourite theme and satisfied that his own work has stood the test of time" The extensive developments of Fischer's work which have resulted from this international activity may readily be appreciated by comparing the chapter headings of the present edition with those of previous editions of the same work—expansion of old fields and the development of entirely new ones are there very well shown

"The Carbohydrates" as a whole will be of great interest and service alike to the sugar specialist and to workers in other fields The biochemist will probably find the last two chapters especially interesting These cover the relation between configuration and biological behaviour, and the problem of the synthesis of carbohydrates in the plant

Quantum Mechanics

Elementary Quantum Mechanics By Dr R W Gurney Pp vi+160 (Cambridge At the University Press, 1934) 8s 6d. net.

THERE is now a number of volumes of an introductory character on the new quantum theory, and in reading them one is struck by the diversity in the methods adopted for introducing the beginner to this subject Some begin with matrix analysis, some with generalised dynamics and others mingle philosophy with physics This diversity is largely due to the fact that there is, as yet, no accepted formal method of approach, nor has it been decided what previous knowledge is to be assumed on the part of the student of the new developments The particular method of teaching the subject will vary according to whether stress is to be laid upon its mathematical or experimental aspect. It would appear that many physicists regard the subject as almost exclusively suited to those with a considerable degree of mathematical training and ability. They will be agreeably surprised to find from this volume that it can be easily studied from the experimental physicist's point of view.

The old quantum theory of the atom began with a study of the properties of the Rutherford model, the new theory begins with the study of the atom as a region of variation of potential The book under notice illustrates the new methods by means of some simple problems and their appropriate energy diagrams The reader is bound to be familiar with those illustrative examples, and he will find that the new problems appear in a garb which is no more unfamiliar than an old friend in a new suit The author's method may well be adopted as the method of choice for beginning this subject, especially for those whose interest lies chiefly in experimental physics

In expanding the subject and in introducing the wave equation, a number of special problems is considered. Some of these are common to most books of this character, such as the problem of the hydrogen atom and of electron spin Others are less familiar and make an appeal to chemists as well as to physicists, such as the subjects of valence bonds and molecular formation A chapter is devoted to electrons in crystals and insulators and conductors

It is not too much to say that of all the good elementary books on the subject, this volume brings out most successfully and simply the physical aspect of the recent theory.

Short Notices

From Galileo to Cosmic Rays a New Look at Physics By Prof H B Lemon Pp xviii+450 (Chicago University of Chicago Press, London Cambridge University Press, 1934) 17s 6d net

THE problem of telling, in simple fashion, something of the fundamental principles of physical science—the ordinary workaday notions which serve to help us in our dealings with a macroscopic world—as well as something of yesterday's sensational developments, is an important and urgent matter, but one of supreme difficulty

What are we to do in order to cater for, not only that exacting fellow, the intelligent layman, but also the undergraduate who is destined to go out in natural science, in the classics, maybe even with that *ægrotat* in botany which was the fate of the Rev. Lancelot Ludovic Soulsby ? He has enough and to spare of expanding and of island universes, he can talk glibly of the principle of indeterminacy Is it possible, in a short, systematic course, to provide him with the essential background, and to give him some intelligent grasp of, say, the law of the conservation of momentum, the measurement of horse-power, the kinetic theory of heat, an explanation of thunderstorms, the propagation of waves, and so to lead him to the story of the nuclear atom, and atomic transmutation ?

Prof. Lemon has made a gallant attempt to achieve the almost impossible, and, in so doing, has pressed into his service most of the devices known to modern pedagogy. a liveliness of exposition that does not degenerate into cheapness, a most unorthodox use of the pictorial art, a number of very fascinating stereoscopic photographs; and an enthusiasm for his subject that never fails him

The result is an arresting volume, in one respect, the book reminds one of the original edition of Maxwell's "Matter and Motion"—it is only the professional who can realise the immense amount of labour which must have gone to its production It makes pleasant and easy reading, which, a *bouleversement* of an almost proverbial saying, affords some measure of the author's industry. A. F.

Board of Education Educational Pamphlets, No 101 · *Senior School Mathematics* Pp 67 (London H M Stationery Office, 1934) 1s. net

THE recent reorganisation of the elementary schools of Great Britain has naturally led to the establishment of a large number of 'senior schools' of various types The Board of Education has therefore published this pamphlet in order to give some guidance to teachers in laying out adequate courses in mathematics adapted to the varying needs of such schools.

After an interesting introduction, there follow ten well written chapters on the scope of the work likely to be of the greatest use to the pupils. Freed from examination preparation and purely formal study, the exploration of a suitable course becomes a very thought-provoking task It will be evident that a senior school will need more especially a practical bias, and in mathematics, this means not only arithmetic of everyday life, but also considerable amount of actual practical work, such as mechanical drawing, simple surveying and the like All these problems are adequately discussed from many points of view, and some excellent suggestions are made. The final two chapters are particularly helpful, for they deal with the difficult and thorny problems of the special course for girls and the treatment of the backward pupil

Progressive teachers of mathematics will be in thorough agreement with the suggestion concerning the unity of the several branches, arithmetic, algebra and geometry, given in par. 26, but it is doubtful whether that measure of agreement will be afforded to the suggestion of par. 72 There seems no valid reason for suppressing the y in plotting a simple algebraic function; indeed, the complete equation $y = f(x)$ leads to a more intelligent grasp of the graphical representation and the relation between variables.

The whole pamphlet, nevertheless, is an inspiring contribution to a difficult problem, and teachers generally will welcome the many excellent suggestions made therein F. G. W. B.

Radio Receiver Measurements. By Roy M. Barnard. Pp. xii+116. (London: Iliffe and Sons, Ltd., n.d.) 4*s.* 6*d.* net.

THIS "concise handbook for the radio service engineer" is a happy augury for the day when radio service will be done by engineers and not by 'black-coat' plumbers. The author is chief inspector of broadcast receivers to a large manufacturing concern, and the quality of the book, within the limits which the author imposes on himself, is sufficiently guaranteed by this fact. The limits are much narrower than the title suggests; tests made on the 1931 schedule, on which the work is based, will fail to give a really adequate representation of receiver performance. The book would, from this point of view, be disappointing and dangerous were it addressed to the testing staff of the manufacturer. But since it is, in fact, addressed to the men who must deal with the set after it has left the factory, the book may be very cordially commended. An urgently needed rise in the standard of radio service work would result from its general circulation, but it is doubtful whether any very large proportion of those now offering themselves as radio service engineers are fitted to benefit by the author's guidance.

It is gratifying to learn that the manufacturing side of the industry is taking steps to improve the situation in this respect. When they have done this, the manufacturers will perhaps find time to turn their eyes back to their own test and inspection departments, which are, in many cases, quite unworthy of their producing departments. Too frequently the inspection department allows the set to reach the customer with faults of a much simpler, but no less annoying, nature than those discussed by Mr. Barnard.

Tiefseebuch: ein Querschnitt durch die neuere Tiefseeforschung. In Beiträgen von C. W. Correns, A. Defant, F. Goszner, W. Stahlberg, O. v. Schubert, H. Wattenberg, G. Wüst. (Das Meer in volkstümlichen Darstellungen, Band 3.) Herausgegeben vom Institut für Meereskunde zu Berlin unter Schriftleitung von Georg Wüst. Pp. vi+144+16 plates. (Berlin: E. S. Mittler und Sohn, 1934.) 4.80 gold marks.

THIS is a compilation showing the present position of research particularly in respect to the deeper waters of the ocean. It is excellently put together, well illustrated and commendably brief. It is divided into as many sections as there are authors, and it advertises the very honourable part that Germany has taken in marine exploration. Route sheets of eight German expeditions are reproduced. Of these expeditions, that of the *Meteor* of 1925-27 will be of most interest to readers, since its scientific results are not as yet generally known, and the present work is largely written by its scientific staff. The *Meteor's* topographical work and that of the *John Murray* expedition, both based on sonic sounding, give a completely new conception of the bottom topography of the oceans. Furthermore, there were new methods and aims, here summarised, in all parts of the work of this expedition, chemical, physical and biological. Many selected sections and charts are given and those of the South Atlantic merit most careful study. We require to settle many problems now by intensive work, especially topographical, physical and chemical, in the Pacific, where questions of circulation, temperature, salinity, etc., are simplified by its open character and great size. This will be clear to all who are interested enough to study this excellent little book.

The Structure of Spectral Terms. By Prof. W. M. Hicks. Pp. xi+209. (London: Methuen and Co., Ltd., 1935.) 10*s.* 6*d.* net.

THE present volume, intended as a supplement to the author's "Analysis of Spectra" which appeared in 1922, sets out at length the results of his investigations during the last twenty-five years. The object of the work—in which Hicks stood alone—is to obtain empirical relations between spectroscopic data and various physical properties of the elements.

As the title suggests, the writer was concerned only with the term values derived from analysis of the observational data, so the first chapter is appropriately devoted to the different formulæ that may be used to represent term series. Useful numerical examples indicate the methods used in practice to adjust the values of the constants in the formula and to evaluate the Rydberg constant.

The next seven chapters present a detailed account of the author's attempts to deduce atomic constants from his own interpretation of line spectra. Satelloids, the 'oun', high order emission, linkages, summation lines, *s*-, *p*-, *d*- and *f*-terms are successively treated, the text being supplemented by numerical tables to illustrate the points under discussion. Finally, the theory of atomic structure is reviewed in relation to the whole of the foregoing results.

Rydberg's term symbols are retained, although they seem to offer no advantages over the usual modern notation, and the text is marred by excessive use of abbreviations.
E. G. J.

The Testing of Bituminous Mixtures: a Laboratory Handbook concerning Road and Building Materials. By Donald C. Broome; with a Chapter on Roofing Felts, by R. O. Child. (The Roadmakers' Library, Vol. 2.) Pp. vii+194. (London: Edward Arnold and Co., 1934.) 15*s.* net.

THE art of road-making is rapidly becoming transformed into a science, which possesses a "Roadmakers' Library" of its own. The bituminous binding materials are now used after study of their chemical and physical characteristics instead of being applied haphazard, a number of the tests have been standardised. The English literature on the subject is scanty, and there is need for a book which brings the existing knowledge together. The two sections deal respectively with the testing of the constituent materials and of the finished mixture, and there are the usual appendixes containing tables. The work is written primarily for those actually engaged in this class of work and should prove of value.

The Negative Proton

By Dr G. Gamow

> Alice laughed "There's no use trying," she said: "one *can't* believe impossible things" "I daresay you haven't had much practice," said the Queen. "When I was your age I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast"
>
> "*Through the Looking Glass*"
>
> LEWIS CARROLL

DURING the last few years, physical knowledge has been considerably enriched by the discovery of several new kinds of particles Besides the old-fashioned protons and electrons, *neutrons*, *positive electrons* and hypothetical *neutrinos* came on to the stage of the physical world However, the discovery of new particles did not make our picture of the physical world more complicated, but on the contrary led to simplification and added to the symmetry of this picture, in fact, the existence of such particles was expected from general theoretical considerations long before their discovery We must notice particularly that the discovery of positive electrons removed the principal problem of the dissymmetry of electric charge, and at the present time the predomination of negative electrons in our observations is just a matter of the part of the universe in which we are living However, this question is still outstanding in connexion with heavier particles, and the only way to remove completely the existing asymmetry in the electric charge would be to introduce the notion of *negative protons* and to prove their existence

It might seem at first sight that the negative protons could be introduced in the same way as positive electrons in Dirac's theory, that is, by considering them as holes in the continuous distribution of protons corresponding to negative energy-levels However, this extension of Dirac's hole theory for protons can be justified only if the Dirac relativistic wave-equations are applicable to these particles, which does not seem to be true In fact, the analysis of the foundations of Dirac's theory given by Bohr has shown that this theory may be applied to a particle only under the condition that *the radius of the particle is small compared with the critical length*. $l = h/mc$ (where m is the mass of the particle in question)

For an electron, we have

$$l_e = \frac{6\cdot 5 \times 10^{-27}}{0\cdot 9 \times 10^{-27} \times 3 \times 10^{+10}} = 2\cdot 4 \times 10^{-10}\ \text{cm}.$$

which is much larger than the radius of the electron estimated from its mass according to the classical relation $r_e = e^2/mc^2$ ($= 3 \times 10^{-13}$ cm). Even if we do not believe in this formula, based on the hypothesis of pure electromagnetic mass for the electron, we can be quite sure that the electron is not so large as 2×10^{-10} cm, because otherwise the finite radius of the electron would be noticeable for the electronic orbits of heavier atoms which have radii of the same order of magnitude. Thus for electrons, the conditions for validity of Dirac's theory are fulfilled and it can be successfully applied with all its consequences

The situation is rather different for a proton, as here the critical length becomes

$$l_p = \frac{6\cdot 5 \times 10^{-27}}{1\cdot 7 \times 10^{-24} \times 3 \times 10^{+10}} = 1\cdot 4 \times 10^{-13}\ \text{cm}$$

Although the direct observations of anomalous scattering of fast protons in hydrogen which would give us the value for the radius of proton have not yet been made*, we have still much evidence that the real radius of the proton is not much smaller than l_p and most probably of the same order of magnitude. General considerations concerning the nuclear model constructed from protons and neutrons show that the stability of such a model can only be secured if we accept the strong repulsion between constituent particles at small distances, which is equivalent to the introduction of 'rigid radii' of the order of magnitude $1\cdot 3 \times 10^{-13}$ cm The same value can be obtained from the experiments on scattering of neutrons in hydrogen One can say, of course, that applying to a proton the same classical mass-radius relation as for an electron, we shall have a much smaller value for the radius ($= 2 \times 10^{-16}$ cm), but the applicability of this relation is based on the hypothesis of pure electromagnetic mass of a proton, which does not seem to be correct for heavy particles; applying the same relation to a neutron, we should have for it the radius zero, which is definitely wrong *Thus it is not to be expected that a proton can be described by Dirac's equations*, and there are no reasons to expect that the consequences of those equations also should hold for a proton. First of all, as indicated by Bohr, the magnetic moment of the proton need not necessarily be given by Dirac's relation $\mu = eh/4\pi cm$, and in fact it was shown by the experiments of Stern and Frisch that this moment *is about two and a half times larger* There is also no justification for speaking of the negative proton level-distribution, of the holes in such a distribution, or of the existence and annihilation of negative protons in the sense of Dirac's theory.

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* Experiments on the scattering of fast protons in hydrogen have been carried out by Wills (Johns Hopkins dissertation, 1934), but the number of observed collisions was not enough to support any conclusions about deviations from Rutherford's scattering formula.

We can ask, of course, what equations must be applied to describe the relativistic quantum motion of a proton. So far, Dirac's equations have been shown to be the only wave-equations mathematically possible which are consistent with the theory of relativity. The most plausible way out from this paradoxical situation would be perhaps to say that we do not need any relativistic quantum equations for a heavy particle in such a case. In fact, we shall need such equations for a proton only in extremely strong fields (not existing even inside nuclei) and it is very probable that under such violent external forces the transformations of a proton into a neutron and vice versa, with the creation of positive and negative electrons ($p \rightarrow n + \overset{+}{\beta}$, $n \rightarrow p + \overset{-}{\beta}$), will happen so often that there will be no longer any physical meaning in speaking about *one particle*. However, even for strong intranuclear fields, the velocities of protons and neutrons are still small compared with the velocity of light, and in these cases the ordinary Schrodinger equations can be applied. It may be that just the fact that the ratio (velocity of nuclear particle/velocity of light) is not exactly zero is responsible for the neutron-proton transformations in the nuclei, for the description of which we must have an as yet unknown theory for the *behaviour* (*motion and transformations*) of heavy particles.

The considerations given above show us that, in introducing negative protons for the sake of considerations of general symmetry, we must not be guided at all by the analogy with the theory of positive electrons. We must choose the properties of this new particle in the way most consistent with the observed symmetry of the physical world. It seems, therefore, most natural to consider the negative proton as symmetrical with the positive proton in respect to a neutron. From this point of view, the mass and the absolute value of charge for a negative proton must be exactly equal to those for a positive one. As already mentioned above, no such process as annihilation must be expected for two kinds of protons, but for the sake of symmetry we have to accept for the negative proton the possibility of transformation into a neutron and vice versa, with the emission of an electron. Thus we obtain the following general scheme of transformations for heavy particles:

$$\overset{-}{\mathrm{P}} \; \underset{\overset{+}{\beta}}{\overset{\overset{-}{\beta}}{\rightleftarrows}} \; n \; \underset{\overset{+}{\beta}}{\overset{\overset{-}{\beta}}{\rightleftarrows}} \; \overset{+}{\mathrm{P}}.$$

We see that for nuclei containing also negative protons the processes of negative- or positive-electron emission can both happen in two different ways; this can be of great use for the explanation of the two different types of β-decay of the same nucleus which are observed, for example, for uranium-X_1 (see later).

The forces between negative protons and other particles can also be obtained to a large extent from symmetry considerations: the interaction between a negative proton and a neutron must be identical with the interaction between a positive proton and neutron as suggested by Heisenberg (a strong attraction, rapidly decreasing with distance, changing to a strong repulsion at very small distances) and the interaction between two negative protons must be mainly due to Coulomb forces. Symmetry considerations cannot, however, give us any idea of the forces between a negative and a positive proton; in order to estimate these, we must consider the general stability conditions of an atomic nucleus. One can show that in order to explain the existence of positively charged stable nuclei, it is necessary to introduce *a rather strong repulsion between two kinds of protons*. In fact, if there were no such repulsion, the most stable state of the nucleus of a given total number of particles of atomic weight A (the state with maximum binding energy) should correspond to $A/2$ neutrons, $A/4$ positive protons and $A/4$ negative protons, because in this case we have the maximum number of neutron-proton-bindings and minimum of repulsive Coulomb forces. Since for real nuclei the most stable state does not correspond to zero charge, we must introduce forces preventing the formation of equal number of positive and negative protons in the nucleus, which can only be done if we accept a very strong repulsion between the two kinds of protons at nuclear distances. Such forces will reduce considerably the number of protons of one kind in any given nucleus, and will permit none or perhaps just one negative proton in the light nuclei and more in heavier ones. Of course, from this point of view, we should expect the existence of negative nuclei with positive electrons circulating around them in some part of our universe.

We come now to an interesting question about the magnetic moments of heavy particles. The symmetry considerations force us to ascribe to a negative proton the magnetic moment of the same absolute value but of opposite sign to that of a positive proton. We must also expect that *the magnetic moment of a neutron is exactly zero*. This seems, however, to cause serious difficulties in understanding the small value of the magnetic moment of a deuton, which according to Stern and Esterman is only about 0·7 nuclear magnetons. In his attempt to explain the observed momenta of atomic nuclei, Schuler argues in the following way. Accepting the spins of neutron and proton as each equal to $\frac{1}{2}$, and supposing that those two particles move in the deuton on the fundamental S-level with the orbital momentum $j = 0$, we must conclude that both spins are parallel in order to explain the observed spin of the deuton, which is equal to 1. Since the magnetic moment of a proton is about 2·5 nuclear magnetons (Stern and Frisch) and the magnetic moment of the deuton only about 0·7 (Stern and Esterman)*, we must conclude that the magnetic moment of the neutron is equal to $0·7 - 2·5 = -1·8$ nuclear magnetons and is directed oppositely to the spin.

One can, however, show that these conclusions are not necessarily unique, and that it is possible to explain the observed values for the deuton while still accepting a magnetic moment of the neutron equal to zero and compensating the magnetic moment of a proton by its orbital magnetic moment. In fact, accepting the fundamental level of two particles in the deuton as a D-level with orbital angular momentum $j = 2$, we can explain the observed spin of this nucleus by supposing that the spins of proton and neutron are both parallel and opposite to the orbital momentum $(2 - \frac{1}{2} - \frac{1}{2} = 1)$. Of course, one can argue against the D-level hypothesis by saying that there is a theorem of wave-mechanics according to which the fundamental state of a system of two particles interacting with central forces is always an S-state. However, it is very doubtful whether this theorem can be applied to our case for, as we have seen, the radii of the two particles in question are of the same order of magnitude as the distance between them in the deuton nucleus. Putting the matter pictorially, one may say that the radius of the S-orbit for a neutron and a proton may be smaller than the sum of the radii of two particles, so that this orbit is excluded by geometrical considerations. In more technical terms, that would mean that *the laws of ordinary wave-mechanics are no longer applicable in detail when the heavy particles more or less penetrate into each other's structure*, which seems to be quite rational if we remember what was said before in this connexion.

It may seem at first that the introduction of a D-orbit would immediately give us two units of magnetic moment to compensate the large moment of the proton. This is not so, however, for since one of the particles is neutral, the total orbital momentum $j = 2$ will give rise only to one unit of magnetic moment. Here again the finite size of the proton comes in to help us. We have seen that for the rotation of a proton around its axis, the *gyromagnetic ratio* is about five times larger than for the rotation of a proton around a distant axis. In the first case we have:

$$\frac{\text{magnetic moment}}{\text{mechanical momentum}} = \frac{2·5}{\frac{1}{2}} = 5\,,$$

and in the second

$$\frac{\text{magnetic moment}}{\text{mechanical momentum}} = \frac{1}{1} = 1$$

The fact that this ratio for the proper rotations of a proton is equal to 5 and not to 2, as required by Dirac's theory, was accounted for by the finite size of a proton, and will be explained only when we know the distribution of charge and mass in this particle. *In any event, we must expect that if the proton is rotating around an axis at a distance comparable with its own radius (which is usually the case in the nuclei) the gyromagnetic ratio for orbital motion must not be expected to be unity but may be considerably larger*: this effect can increase the orbital magnetic moment of a proton in the deuton nucleus to a large extent and make the total magnetic moment of the deuton sufficiently small. It should be noticed, of course, that the above considerations do not pretend to give any explanation of the observed magnetic moments of nuclei, but just show that one must be very careful when drawing definite conclusions in this region before the theory of heavy particles is really constructed.

One of the most interesting applications of negative protons to the theory of nuclear structure is the possibility of the existence of nuclei with equal atomic numbers and equal atomic weight but still possessing different structure and different properties. Such *isomeric nuclei* can be obtained if we replace a pair of nuclear neutrons by one positive and one negative proton. Two such nuclei evidently possess the same mass and charge, but may have different spins and different binding-energies (mass-defects). One of such isomeric nuclei possessing larger energy will usually be unstable and subject to transformation into the other isomer by the simultaneous internal transformation of two particles

$$\begin{array}{c} \overset{+}{p} \rightarrow n \\ \overset{-}{p} \rightarrow n \end{array} \quad \text{or} \quad \begin{array}{c} n \rightarrow \overset{+}{p} \\ n \rightarrow \overset{-}{p} \end{array}\,,$$

however, the probability of such double transformations (just as in the case of double α- or β-emission) is extremely small and we should expect such isomeric nuclei to be metastable. Thus the isomeric nucleus will differ widely from an ordinary excited state of a nucleus, for which the emission of surplus energy in the form of a γ-quantum usually takes place in a very small fraction of a second ($\sim 10^{-14}$ sec.).

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* Both values with considerable probable error.

We can give an example in which the notion of isomeric nuclei may be of great use In the region of the heavy elements there exist the stable isotope of lead ${}_{82}Pb^{210}$ found by Aston* which is isomeric with β-decaying RaD, and the isomeric nuclei UX_2 and UZ resulting by β-forking from UX_1 and both giving after the emission of a second β-particle the nucleus of U_{II} In the last case, two different β-branches leading from UX_1 to U_{II} $UX_1 \xrightarrow{\bar{\beta}} UX_2 \xrightarrow{\bar{\beta}} U_{II}$ and $UX_1 \xrightarrow{\bar{\beta}} UZ \xrightarrow{\bar{\beta}} U_{II}$ may be considered as due to the above mentioned two possibilities for $\bar{\beta}$-emission $n\bar{p} \xrightarrow{\bar{\beta}^{+}} p\bar{p} \xrightarrow{\bar{\beta}^{+}} pn$ and $np \xrightarrow{\bar{\beta}} nn \xrightarrow{\bar{\beta}^{+}} pn$ giving rise to isomeric nuclei at the half-way stage

It is interesting to notice here that the negative protons are the only particles, apart from neutrons, for which there are no potential barriers around the nuclei, and therefore one would expect that substitutional reactions of the type

$${}_nX^m + {}_0n^1 \rightarrow {}_{n+1}Y^m + {}_{-1}p^1$$

would be probable even for the heaviest elements It is not impossible that some of the Fermi reactions for heavy elements may be explained on this basis

In conclusion, we may say that there are so many indications of the existence of negative protons that the hope is justified that these as yet hypothetical particles, completing the symmetry of the physical world, will be found sooner or later.

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* The existence of this isotope is unfortunately not quite definitely proved

Progress in Medical Research*

THE report of the Medical Research Council for 1933–34 reveals the wide boundaries within which investigations relating to health and disease are being initiated and supported throughout Great Britain, and reflects the rapid development of medical science as well as the need for scientific knowledge as a guide in practical affairs Parliament provided a grant-in-aid of £139,000 for the Council's expenditure during the present financial year, the provisional allocation of which is, for administration £9,000, for the expenses of the National Institute for Medical Research including the farm laboratories £54,000 and for research grants to scientific workers and for the investigations of the Industrial Health Research Board £76,000 The funds available have, as usual, been augmented from other sources for the promotion of particular schemes of research

Lord D'Abernon resigned his membership of the Council, the vacancy was filled by the appointment of the Marquess of Linlithgow, who was also elected chairman of the Council in succession to Lord D'Abernon. Prof. E Mellanby also resigned his membership on being appointed secretary of the Council, Prof H. S Raper was appointed to succeed him. Sir Charles Sherrington and Dr J A Arkwright retired and Prof A J. Clark and Prof J C G Ledingham were appointed members It was decided that the tribute to the late Sir Walter Morley Fletcher, for which funds had been collected during the year, should consist in the first place of a personal memorial, in the form of a portrait bust to be placed in a suitable setting in the National Institute for Medical Research, and secondly of the inception of some scheme for the advancement of knowledge for the relief of human suffering, which, it is proposed, should be the foundation of a Walter Fletcher Laboratory at Mill Hill, to be devoted particularly to nutritional studies

The Department of Biological Standards at the National Institute now holds twenty-three different standards Thirty-three different countries, including British Dominions, have been supplied with samples of some of them during the year The standards for gas gangrene antitoxin, staphylococcus antitoxin and two anti-pneumococcus sera, prepared at the Institute, have now been adopted by the Permanent Commission on Biological Standardisation of the League of Nations, and units defined in terms of them They will be preserved at the State Serum Institute, Copenhagen, for international distribution The work carried out on vitamin standards by and for the Accessory Food Factors Committee was reported to the second International Conference on Vitamin Standards held in London last June the National Institute continues to hold the four standards for vitamins A, B_1, C and D and is responsible for their international distribution

In the field of clinical research the Council has applied the funds released by the permanent endowment by the Rockefeller Foundation of the post held by Sir Thomas Lewis at University College Hospital, to the establishment of a new Clinical Research Unit at Guy's Hospital, Dr R T. Grant has been appointed director The opportunities for clinical research are steadily widening The report refers to the departments established during the past few years, including those at the National Hospital for Nervous Diseases, Queen Square, at King's College Hospital, at the Middlesex Hospital and finally at the new British Postgraduate Medical School, for which funds have been supplied by various benefactors or responsible authorities

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* Committee of the Privy Council for Medical Research · Report of the Medical Research Council for the Year 1933–34 (Cmd 4796) Pp 172. (London H M. Stationary Office, 1935) 3s net

The work on viruses at the National Institute has been actively continued. The important discovery by Laidlaw, Andrewes and Wilson Smith that the virus of human influenza can be transferred to ferrets, mentioned in last year's report, has opened up a new line of attack on the problems of this disease It has now been found that mice can be infected from ferrets by suitable methods, for example, intranasal inoculation under light ether anæsthesia The animals show signs of illness of a pneumonic type, which is usually fatal The disease can be transmitted from mouse to mouse and from mouse back again to ferret the direct infection of mouse from man has not yet been attempted, in the absence of an epidemic of influenza. The virus has been detected in the throat washings of only one case of illness, clinically diagnosed as 'influenza', out of a number examined The method of transmission to the mice is of crucial importance, and there is no evidence of a natural spread of the disease from infected animals to others living with them Neutralising sera can be obtained from the ferret, horse and pig after infection with the virus, and the blood serum of practically all human subjects recently examined contains such a neutralising antibody The infection for the mouse can be neutralised by ferret serum and the animal afterwards rendered hyper-immune by repeated administration of the virus The influenza virus is very similar to that found by American workers in 'hog influenza', which causes a severe illness in the ferret or mouse · the original disease in swine, however, is caused only by the joint action of the virus and a visible bacterium

Sir Henry Dale, working with Drs. Gaddum, Feldberg and Vartiainen, has continued his experiments on the nature of the process by which nervous impulses are transmitted from the nerve endings to the cells under their control It is highly probable that the effectiveness of practically all messages passing from the central nervous system to voluntary muscles and other organs of the body depends upon the liberation, at particular points of their course, of acetylcholine In the case of the sympathetic nervous system, however, the substance liberated at most nerve endings is related to adrenaline. An exception is the nerve-supply to the sweat glands, which, although belonging to the sympathetic system, yet, in the cat at any rate, acts by the liberation of acetylcholine. Sir Henry Dale has used the words 'cholinergic' and 'adrenergic' for nerve fibres the effects of which are transmitted by acetylcholine and a substance related to adrenaline respectively It now appears that the preganglionic fibres of the whole autonomic system and the motor fibres to striated skeletal muscle are cholinergic, together with the postganglionic fibres of the parasympathetic division of the autonomic system , the postganglionic fibres of the sympathetic system are predominantly, but not exclusively, adrenergic These observations throw light on the experiments of Langley and Anderson thirty years ago on the replacement of the fibres of one nerve by those of another in regeneration They showed that voluntary motor fibres and preganglionic fibres of any part of the autonomic system could functionally replace one another, or postganglionic fibres of the parasympathetic system, but not postganglionic fibres of the sympathetic system These observations can now be summarised by saying that cholinergic fibres are interchangeable with other cholinergic fibres, and adrenergic with other adrenergic fibres, but that fibres employing different methods of chemical transmission cannot replace one another.

Another type of evidence showing the importance of specific chemical substances in the working of the nervous system has been brought to light by nutritional experiments, for example, the work of Peters on the rôle of vitamin B_1 in the oxidation of carbohydrate in the brain and of Mellanby on the degenerative changes occurring in nerve cells and their conducting fibres when the supply of vitamin A or carotene in the diet is insufficient. The fibres and cells chiefly affected are the afferent, and their degeneration is followed, or accompanied by, changes in the epithelial surfaces connected with them, resulting in microbial infection It appears that nerve cells may play a much larger part in aiding the defence of certain tissues against infection than had previously been suspected.

Among the many other investigations carried out by, and for, the Council, that on 'accident proneness' has a special interest at the present time. Recent work has widened the field of inquiry from that of ordinary industrial risks, to include the study of road accidents With regard to the former, it is now well established that certain persons have a special liability to be the subjects of accidents ; for example, 10 per cent of a group may be responsible for 75 per cent of the accidents occurring amongst them. The phenomenon is independent of any question of responsibility or blameworthiness. It has been found that those who sustain an undue number of one kind of accident also sustain an undue number of other kinds, and that accident proneness is a relatively stable quality, so that if those who have an undue number of accidents in their first year of exposure are eliminated, the subsequent accident ratio of the group is diminished A similar relationship has been found to hold for motor accidents The elimination (on paper) of those who sustain an undue number of accidents in an initial period of exposure reduces the accident rate shown by the remainder of the group in the subsequent period The report suggests that data are already available, in the records of the insurance companies, for giving a trial to this method of accident prevention on a large scale. The novelty of the method, as compared with judicial disqualification, lies in the facts that it makes use of information provided by minor accidents and that it is dissociated from any question of blame, since a man cannot be blamed because his reactions are slower than those of others Yet it appears reasonable that he should be removed from a position in which he is a danger to himself and others, or by appropriate tests be prevented from reaching this position.

Obituary

SIR JAMES WALKER, F.R.S

THE death of Sir James Walker at Edinburgh on May 6, in his seventy-third year, severs one of the last links between classical and modern physical chemistry Closely connected in work and friendship with the three great founders of the science on the Continent—van't Hoff, Ostwald and Arrhenius—Walker may be justly regarded, indeed, as the protagonist of physical chemistry in Great Britain during the last forty years. His text-book, 'Introduction to Physical Chemistry", has passed through ten editions since its first appearance in 1899, and has probably assisted more students towards an easy, yet serious, appreciation of the science than any other single volume. Several of the more significant chapters of the subject—for example, those on hydrolysis and amphoteric electrolytes—were largely his own original work Walker was also, however, a skilled organic chemist, and his success in attacking purely technical problems was exceptional In an age of increasing specialisation, he retained to the last an unusually wide range of interests, and kept himself up to date in a great many diverse fields. Remembering the bitter controversies in which he participated as a young man, while the revolutionary ideas regarding the nature of solutions were being forced upon his reluctant seniors, he was always particularly open-minded in his attitude towards the work of the second generation of physical chemists which has recently effected another revolution in this same field He recognised quite complacently that, if they could see farther than Arrhenius, it was, after all, only because they were standing on Arrhenius's shoulders.

Born in Dundee in 1863, and educated at Dundee High School, Walker entered the University of Edinburgh in 1882 and was inspired by Crum Brown to seek an academic career in chemistry After obtaining the degree of D.Sc for his thesis on "The Dehydration of the Metallic Hydroxides by Heat", in 1886 he proceeded to Baeyer's laboratory in Munich to engage in organic research, but at the end of six months, learning that Ostwald had been appointed professor of physical chemistry at Leipzig, he hastened to become the first British pupil of that new school, and graduated therefrom as Ph.D. in 1889 with a thesis on "The Affinity Constants of Organic Bases"

For the next three years, Walker served as research assistant to Crum Brown at Edinburgh, his most outstanding contribution being on the electrolytic synthesis of organic acids. In this period falls also the inauguration of the Alembic Club, an association of assistants in the chemistry department which afterwards undertook the publication of fundamental papers of historical interest—the Alembic Club Reprints—with gratifying success

An introduction to Ramsay at the memorable Leeds meeting of the British Association in 1890, where van't Hoff and Ostwald triumphantly vindicated their views against a mass attack of their opponents, led Walker in 1892 to enter Ramsay's laboratory in University College, London, first as a research worker and later as an assistant In 1894 he was selected to succeed Percy Frankland in the chair of chemistry at University College, Dundee, and for fourteen years he occupied that post in his native town, adding steadily to his reputation for research, teaching and administrative ability. He was elected a fellow of the Royal Society in 1900, and when his old teacher, Crum Brown, resigned in 1908, Walker was appointed to fill the vacancy at Edinburgh.

Here Walker found that his first and most urgent duty was the reorganisation of the laboratories, which had become entirely inadequate. The solution of this problem was delayed until after the War, but the new Department of Chemistry at King's Buildings, completed in 1924 and still unrivalled in Great Britain, constitutes a fitting memorial to his twenty years occupancy of the Edinburgh chair During the War he rendered valuable services to the country by erecting and equipping, in conjunction with some of his colleagues in the Department, a factory for the manufacture of T.N T which produced as much as fifty tons of the explosive weekly. The efficiency of the plant may be illustrated by the statement of the Department of Explosives Supply that its figures for nitrogen economy during the months of September and October, 1918, constituted a record for the country.

In 1921 Walker received a knighthood and was also elected to the presidency of the Chemical Society.

His expert advice was sought by many committees—such as the Fuel Research Board, the Advisory Council for Scientific and Industrial Research, the University Grants Committee, and the Carnegie Trust—to all of which he gave generous and conscientious service. He was awarded the Davy Medal of the Royal Society in 1926. The Royal Society of Edinburgh honoured him at the beginning of his career with the Makdougall-Brisbane Medal in 1895, and at its close with the Gunning Victoria Jubilee Prize in 1933. He was an LL.D. of the Universities of St. Andrews and Edinburgh.

Although he retired from the Edinburgh chair of chemistry in 1928, Sir James Walker maintained for several years an active interest in his old department, visiting it almost daily and participating in a most stimulating manner in its various research activities. His many friends hoped that this Indian summer of his life-time would prove of long duration, but it was not to be. As his body weakened, his visits became regretfully rarer, but the spirit of James Walker was going strong to the very end.

Walker was a man of singular simplicity and charm, working unselfishly always for his department and for his profession. He possessed a remarkable gift for languages (for years he abstracted Russian papers for the *Journal of the Chemical Society*) and an intense love of music. He is survived by his wife, the daughter of Lieut.-Colonel W. Sedgwick of Godalming, whom he met as a research student at University College, and by a son, Dr. Frederick Walker, now lecturer in geology in the University of St. Andrews. His scientific progeny, however, including not only those who have studied directly under him but also those who have been inspired by his writings, are legion. Wherever physical chemistry is mentioned among English-speaking chemists, the first name that springs to mind is that of Sir James Walker.

JAMES KENDALL

WE regret to announce the following deaths:

Dr. Charles E. St. John, research associate at the Mount Wilson Observatory, Pasadena, and associate of the Royal Astronomical Society, on April 26, aged seventy-eight years.

Prof. Hugo de Vries, For. Mem. R.S., emeritus professor of botany in the University of Amsterdam, on May 20, aged eighty-seven years.

News and Views

Sir Robert Muir, F.R.S.

BY common consent, Sir Robert Muir, professor of pathology in the University of Glasgow, is the leader of British pathology, as was shown by the enthusiasm with which his colleagues gathered together last year to testify to their respect and affection for him and to celebrate his seventieth birthday. The recent award to him of the Lister Medal is a proper recognition of the value of his work to surgeons as well as pathologists. This Medal is awarded triennially, irrespective of nationality, for distinguished contributions to surgical science; it consists of a bronze medal and a sum of £500. Sir Robert is an old-fashioned all-round pathologist, morbid anatomist and bacteriologist, and his own researches have covered a wide field—anæmia, immunity, tumours, iron metabolism, etc. He has illuminated any subject to which he has been drawn to pay attention, and his comprehensive knowledge has been spread beyond his immediate pupils by two popular textbooks on pathology and bacteriology, the latter originally written in partnership with his friend James Ritchie, and by the number of his pupils who hold chairs and other positions of distinction in pathology in Britain and the Dominions, where they no doubt reproduce some of his teaching though they can scarcely duplicate his personality.

Prof. P. Zeeman, For.Mem.R.S.

PROF. PIETER ZEEMAN is seventy years of age on May 25 and in consequence retires from the professorship of physics and directorship of the Physical Institute of the University of Amsterdam. In order to allow his many admirers an opportunity of showing their appreciation of his important contributions to science, it is proposed that a jubilee volume be published, to which thirty distinguished physicists have already promised contributions, and that a Zeeman fund, a Zeeman medal or some similar method of encouraging research be founded. A general committee with representatives from all parts of the world has been formed with an executive committee under Prof. J. D. van der Waals, Jr., with T. L. de Bruin, of 33 Gerard Terborgstraat, Amsterdam S. as secretary and treasurer to carry out the proposals, and an appeal is now made for funds in support of the scheme. Pieter Zeeman was born in Zeeland at the mouth of the Schele and was educated at the University of Leyden. In 1890, when twenty-five years of age, he was appointed assistant on the physics staff, and held the post of *privatdozent* when six years afterwards he detected the effect of a magnetic field on the light sent out by a source placed in the field, each line of the normal spectrum being split up into a number of components each polarised and in general displaced. Prof. Lorentz based his explanation on the motion of electrons in the field, but this has been replaced by the quantum theory of the permitted energy of the emitter, which explains the anomalous, as well as the normal, effect. Zeeman was appointed professor of physics in the University of Amsterdam in 1900, was Nobel laureate in physics in 1902, was elected a foreign member of the Royal Society in 1921 and awarded the Rumford Medal of the Society in 1922. The most important of Zeeman's later work was concerned with the convection of light by moving liquids and solids. He found that its magnitude depends on the dispersion of the medium as well as its refractive index, in agreement with the theory of Lorentz rather than with the older one of Fizeau.

Dr. A. C. Haddon

CONGRATULATIONS are due to Dr. A. C. Haddon, of Christ's College, Cambridge, and formerly reader in ethnology in the University, on the attainment, on May 24, of the age of eighty years. Apart from his personal qualities, of which this is not the place to speak, Dr. Haddon's lifelong and unselfish devotion to scientific research have won him the admiration and respect of a wide circle; while his originality of thought and his scientific achievement hold a commanding position in anthropological studies, which has stood unchallenged for more than a generation. When in the course of his first visit to the Torres Straits he turned from zoology to the study of the native peoples, the technique of ethnological investigation in the field was in its infancy. The great expedition to the Torres Straits, which he organised later, in the closing years of the nineteenth century, under the auspices of the University of Cambridge, has been an inspiration and a model for all the more important of the expeditions of ethnological investigation which have followed.

THE Torres Straits expedition served also as a training school, for of those who accompanied Dr. Haddon, the late Dr. W. H. R. Rivers and Prof. C. G. Seligman in their turn became great teachers, and in the field and the lecture-room developed and passed on his methods and ideals to generations of students. Dr. Haddon's insistence on the importance of field-work has become a fundamental principle in modern ethnological training; and his stress on its urgency has ensured many a record of custom and institution which otherwise might have been lost owing to rapid change among the backward peoples. His efforts in promoting the training in anthropology of officials and missionaries have been no less beneficial to science than to the Empire, and in the organisation of anthropological studies in Great Britain his influence has long been profound and far-reaching. We wish him still some years in which to enjoy the fruits of his labours in contemplating the continued advance of anthropological science.

Centenary of the Royal Observatory of Belgium

THE Royal Observatory at Uccle has just celebrated its first centenary by a number of official functions. At the opening ceremony, which was graced by the presence of His Majesty the King of Belgium, addresses were read on the history of the Observatory by the director, M. Paul Stroobant, and on Adolphe Quetelet the founder of the Observatory by M. Demoulin, president of the Observatory Council. Receptions were given at the Hotel de Ville by Burgomaster Max and at the Fondation Universitaire. But the event of chief scientific interest was the visit to the Observatory itself, when the Minister of Education inaugurated a number of new instruments obtained with the aid of a generous Government grant. Amongst these mention must be made of an Askania meridian circle, a Zeiss double astrograph, a 1-metre Zeiss reflector and a number of auxiliary pieces of apparatus. The meridian circle is provided with a number of electrical devices and gives a photographic record of the reading circles for each observation; it can be reversed in 30 seconds. The Zeiss double astrograph is of focal length 2 m., working at *f*/5; the object glasses are quadruplets designed by Sonnefeld. The Zeiss reflector works at *f*/3 at the Newtonian focus for direct photography, but it is hoped later to add a Ross correcting lens. A 2-prism spectrograph is provided for use with the telescope as a Cassegrain reflector at *f*/10. The whole of the recently acquired equipment, on which the Observatory and its director are to be congratulated, is described in full detail in the *Bull. ast. de l'Obs. roy. de Belgique*, **2**, 1935. The British delegates attending the centenary were Dr. L. J. Comrie, director of the Nautical Almanac, Mr. J. H. Reynolds, president of the Royal Astronomical Society, and Prof. F. J. M. Stratton, general secretary of the International Astronomical Union.

Search for Oil in Great Britain

THE danger of dependency on foreign supplies of liquid fuel and the necessity of finding alternative domestic resources are now openly avowed by all thinking people. There are some who fervently believe that there is sufficient petroleum below the ground in England to supply the entire demand for petrol and oil for an indefinite period, and are prepared to back their opinions financially, in spite of adverse geological opinion (NATURE, March 31, 1934, p. 487). The regulations prepared by the Mines Department of the Board of Trade under the Petroleum Production Act constitute an official invitation to those people to prove their theory. At the same time they safeguard the interests of the State in the event of a systematic search for oil proving successful, and ensure that development of any resources found will be conducted in an orderly manner. The essential facts are that if no negative resolution is passed by either House within the twenty-eight Parliamentary days, both prospecting and mining licences will be issued under these regulations. Applicants for such licences must furnish evidence of their technical and financial qualifications and then on payment of the requisite fee, £20 for a prospecting licence or £50 for a mining licence, will be entitled to a monopoly of the area covered. The prospecting licence is tenable for three years and may be renewed for two further yearly periods; the mining licence for fifty years with the possible extension for a further twenty-five years. Prospecting licences will be granted in respect of areas not exceeding 200 square miles or less than 8 square miles, and mining licences in respect of areas neither larger than 100 square miles nor smaller than 4 square miles. The rate of royalty payable to the State has not yet been fixed but it will not be less than 3*s*. nor greater than 6*s*. per ton of crude oil. For any 'casinghead' spirit recovered, the royalty imposed will be not less than one-eighth of a penny or more than 2*d*. per gallon.

Afforestation and Scenery in Great Britain

DURING the past few months, a number of letters and articles have appeared in the Press and in journals regarding the damaging effects of afforestation on the landscape of Britain. In some cases, the Forestry Commissioners have, rightly or wrongly, come in for adverse criticism on the ground of having desecrated some of England's beauty spots, notably in the Lake District, by planting serried ranks of conifers. We may assume that even the Forestry Commissioners have souls, and that they are not wholly devoid of the aesthetic sense, but they have a duty to perform to the nation, that of providing an adequate reserve of standing timber, and however great may be their desire to avoid any action which might seriously affect the beauty of the countryside, they cannot be expected to be entirely impartial judges in matters affecting their programme of work. Here there is more than one interest involved, and in cases where interests conflict, the wise thing is for the parties concerned to meet and come to a friendly agreement. We therefore welcome the announcement that the Forestry Commissioners and the Council for the Preservation of Rural England have set up a joint informal committee, which will meet from time to time and endeavour to come to an agreement in cases where their respective interests are likely to clash. It is hoped that this will be the means of maintaining the beauty of the country without seriously affecting the important work being carried out by the Forestry Commission.

Holly Lodge Farm

AT a meeting on May 16 of the Select Committee of the House of Commons on Unopposed Bills, the Metropolitan Water Board Bill was considered. Under this Bill, it is sought to construct various new works, including a reservoir covering 417 acres in the Staines area and another about 374 acres in extent in the Walton and Weybridge area. This latter will involve submerging Mr. F. W. Secrett's Holly Lodge Farm (see NATURE, February 2, p. 177, and February 9, p. 228). On behalf of the Metropolitan Water Board it was stated that the farm has been brought to a very high state of cultivation, chiefly by the use of artificial manures, and also due to the fact that the soil is of a certain consistency. It is not contended that there is no other soil in the country of the same physical consistency, or which could not be brought finally to an equal state of high cultivation. Indeed, if there were not, then this farm of 180 acres could not be considered to be of the slightest use to the nation. The arrangement is that the lessee of the farm shall remain in possession for at least two years, in order that, if he thinks fit to do so, he will have time to change to another farm on which he may carry on his very useful work. The Committee found the preamble of the Bill proved, and it was ordered to be reported for third reading.

The Green Flash

SINCE the appearance in NATURE of May 4 of the letter by Prof. Worley, with a brief comment by Lord Rayleigh, on this subject, further correspondence has been received confirming the suggestion that "the green flash is by no means a rare phenomenon". Mr. H. Cary Gilson, Trinity College, Cambridge, states that he has observed the flash several times during the past five years from a point in Sussex 150 ft. above sea-level. In October 1933, while in the Gulf of Aden with the John Murray Expedition, "the flash could be clearly seen, with or without glasses, almost any evening", and was even observed from a port-hole about 18 in. above the water. Mr. Northcote Thomas, Grove Cottage, West Malvern, Worcs, has sent a summary of observations made from the upper part of West Malvern, 800 ft. above sea-level. He states that a flash or similar phenomenon was seen on forty-one occasions between July 25, 1934, and April 20, 1935. The flash was green until about mid-September; blue or green from September 17 until October 8; blue from October 11 onwards. On occasions the colour persisted for half a minute. Previous volumes of NATURE will show that the green flash has already received considerable attention, and index entries to letters on the subject will be found in vols. 93–95, 110, 111, 120–123. The comparative frequency of the occurrence and the change of colour to blue were referred to, and also its appearance at sunrise as well as sunset. The weight of evidence, and particularly the sunrise effect, points to a physical explanation of the phenomenon, which is accepted by Prof. R. W. Wood in a letter in NATURE of March 31, 1928 (p. 501), where he suggests that the relative temperature of the atmosphere and the surface with which it is in contact is the determining factor; a cold surface with warm atmosphere would increase the normal gradient of refractive index, and also the curvature of the rays, so delaying 'sunset' and affording "greater opportunity for atmospheric dispersion to come into play".

Memorial to the late Dr. W. C. Unwin

BY the older engineers of the present day, the late Prof. W. C. Unwin will be remembered as an outstanding figure in the fields of engineering education and the practical application of scientific principles to the needs of civil and mechanical engineers. In his long career, which covered the latter half of the last century and the first quarter of the present, he witnessed the greater part of the evolution of engineering as we know it to-day, and in all the branches of the profession with which he was more directly concerned he occupied a pre-eminent position. He died on March 17, 1933, aged ninety-four years; an appreciation of his life and work appeared in NATURE of May 13, 1933 (p. 681). A representative committee, under the chairmanship of Sir Alfred Chatterton, of Unwin's friends and old students, supported by representatives of the Royal Society, the principal British and American engineering societies and of the educational organisations with which he was connected, has now been formed for the purpose of establishing a suitable memorial. The committee is endeavouring to raise funds for the founding of an Unwin scholarship at the City and

Guilds (Engineering) College, of which Unwin was the first professor of civil and mechanical engineering and the first dean, and to publish a biographical memoir based upon the one which was published in the Unwin Memorial issue of the *Central*, the journal of the City and Guilds College Old Students' Association, and so make available a record which so far has only been published for private circulation. Fuller particulars of the Committee's proposal can be obtained from the joint honorary secretaries, Messrs. G. A. Hicks and J. Severs, c/o The Institution of Civil Engineers, Great George Street, S.W.1, and contributions to the fund should be sent to the honorary treasurer, Mr. E. G. Walker, 82 Victoria Street, London, S.W.1.

Communications and the Manufacturer

THE fourth of the "Green Papers" issued by the Post Office contains a lecture by E. S. Byng to the P.O. Telephone and Telegraph Society read on January 15, 1934. He points out that the outstanding success of telephone development in the United States is attributed in some measure to the close working arrangement between the operating and manufacturing departments of the business. In the Bell system, the various operating companies and manufacturing associations are controlled by the American Telegraph and Telephone Co. In Great Britain, the State, as owner of the whole system, does not attempt to manufacture to any appreciable extent. The production of the necessary materials and plant is rightly entrusted to industrial companies. By mutual co-operation and understanding, the Post Office and the manufacturers should be able to operate in much the same way as a single organisation. Of recent years, after work has been begun on a contract, engineers rarely ask for changes to be incorporated. Inspection in a factory may be likened to a running commentary on manufacture, as the inspection includes observing, reporting and criticising. It varies from so little as 2 per cent to 100 per cent of the total goods manufactured. Some processes call for continual vigilance, while others have mechanical safeguards against inaccurate performance. The telephone dial alone consists of nearly seventy 'piece' parts each of which must be checked for accuracy of forming and its dimensions gauged between the maximum and minimum limits. In succeeding stages, the tensions of the springs are measured, the dimensions to the thousandths of an inch and the speed of operation to thousandths of a second.

A New Domestic Coke

A REPORT issued by the Department of Scientific and Industrial Research (H.M. Stationery Office, 9*d.* net) records a test by the Director of Fuel Research on a plant erected by the British Coal Distillation Co., Ltd., at Newbold, Leics., and designed to prepare a smokeless fuel from an entirely non-coking coal, high in ash. The unwashed coal is first dried and passed through a revolving inclined retort, where it is carbonised at 600° C. by hot products of combustion of producer gas. The residue from the retort is discharged into a trough of water, and the 'clean' coke, which floats, is skimmed off the surface, while the dirt sinks and after removal is used for fuel on the plant. The resultant 'clean' coke is made with pitch into briquettes, which are stored to give a domestic fuel. The throughput of the plant as claimed—100 tons per day—was substantially confirmed, giving a fuel which was considered satisfactory for the open grate, a notable achievement for such a raw material. This is a technical test made in accordance with the normal practice of the Department, and does not purport to give an opinion about the commercial success of the process.

Journal of the Royal Horticultural Society

WITH the publication of vol. 49, Part 3, in September 1934, the *Journal of the Royal Horticultural Society* became a useful and informative monthly publication instead of a quarterly or half-yearly volume. The change should be welcome to all concerned, and certainly it will enable the Society to inform members of its activities more efficiently. Lord Aberconway, president of the Society, outlined the main features of the change in the September issue. The *Journal* has maintained a high standard of learning, science and practice for nearly fifty years, and has grown from a tiny circulation to a very large one. The new arrangement is designed "to add rather than to replace. . . . Records will be more up-to-date, news can be given while it is still fresh, information of coming events can be made available; notes of more immediate interest can be introduced; the most recent information as to the Society's activities at Wisley can be included". The "Book of Arrangements" will no longer be issued, but the information will be included in the January and February numbers of the *Journal*. The parts which have appeared since the change was effected show that the standard is even higher, if that is possible, than of old, whilst the total volume of subject-matter seems to have increased.

National Research Council, Canada

THE seventeenth annual report, for 1933–34, of the National Research Council of Canada, in addition to reviewing the researches on analysis and testing conducted in the National Research Laboratories, gives a summary of the activities of associate committees and of assisted researches in university and other laboratories and under scholarships. A financial statement is included, together with particulars of the personnel of the various research, advisory and special committees. Among the researches completed in the National Research Laboratories during the year may be mentioned investigations on the suitability of Canadian clays for oil-refining, the bonding of rubber to metal, the chemical investigation of Canadian weeds poisonous to livestock, the suitability of Canadian wools for the manufacture of cloth, the causes of premature seeding in turnips, the stability of aircraft floats and the correction of instability in aircraft used for photographic survey work. Researches conducted under associate committees have dealt with methods for combating losses due to animal and plant diseases; the evaluation of insulating materials, the incidence and control of dangerous parasites in the livestock and wild life of Canada; the distribution and eradication of destructive weeds. Increasing use is being made of the research information service, and attention is directed to the desirability of expanding the National Research Library. The report surveys the outlook for the work of the Council, and concludes that every indication points to the more intensive application of science to industry, including agriculture, than in the past. The opportunities in the survey of resources, in standardisation, and particularly in the building industry and the utilisation of agricultural wastes, are stressed.

Institute of Physics

The annual general meeting of the Institute of Physics was held on May 14 After election of officers and completion of the panel of the Board, it was announced that the following would take office on October 1 *President*, Prof. A Fowler, *Vice-President*, Dr. G W. C Kaye, *Honorary Treasurer*, Major C E S. Phillips; *Honorary Secretary*, Prof J A. Crowther, *New Members of the Board*, Mr. A. P. M Fleming and Dr B L Worsnop The annual report for the year 1934 states that the total membership of the Institute at the end of that year was 753. New activities have included the holding of informal discussions on industrial physics and the completion of the scheme for the training of laboratory assistants and the issuing of certificates of competence in laboratory arts The report shows that employers are making greater use of the services of the panel of consulting physicists and of the appointments register.

International Conference on Documentation

The thirteenth International Conference of the International Institute of Documentation will be held in Copenhagen on September 9–14, under the presidency of Dr Alingh Prins. The following subjects will be considered. methods of documentation, theory of classification, indexing and abstracting services, co-operation between libraries and abstracting services, statistics, cataloguing, rights of authors in respect to photo-copies, decimal classification and classification of standards and patents, and also classification in municipal administration. Further information can be obtained from Mr E. Lancaster-Jones, Honorary Secretary of the British Society for International Bibliography, Science Library, South Kensington, London, S W.7

Congress of Physical Education

The Belgian Medical Society of Physical Education and Sport has organised an international congress to be held at Brussels on June 30–July 3, when the following subjects among others will be discussed: motor tests in physical education, introduced by Prof. Laugier (Paris), Covaciu Ulmeanu (Bucharest) and René Ledert (Liège), cycling, introduced by Prof. Hedon (Montpellier), W. Missiuro (Warsaw), Brandt (Geneva) and Prof. C. Heymans (Ghent). The subscription is a hundred Belgian francs. Further information can be obtained from the secretary, M. Rebuffat, 50 rue de l'Abbaye, Brussels.

Conference on Spectroscopy

A third special programme on "Spectroscopy and its Applications" is to be held at the Massachusetts Institute of Technology this summer, culminating in a research conference during the week July 15–20. This conference, which is to be held in the George Eastman Research Laboratories, will comprise lectures and discussions on photographic photometry, absorption spectrophotometry, spectroscopic analysis of materials, biological and chemical effects of spectral radiation, spectroscopy of the extreme ultra-violet, and astronomical applications of spectroscopy The meetings of the first day will be largely devoted to consideration of general spectroscopic problems of the metallurgist, chemist and biologist; on July 16 and 17 the chief emphasis will be on specific applications of spectroscopy to biology and medicine. During the latter part of the week, applications of spectroscopy to astronomy will be emphasised, a portion of the programme being held in collaboration with the Harvard Observatory Summer School The research conference coincides with the conclusion of the Institute summer school courses in practical spectroscopy, and the meetings are open to all interested persons An invitation is being extended by the Institute to all properly qualified investigators, to make use of the facilities of the spectroscopy laboratory in connexion with their researches during such portions of the summer months as they may desire. A bulletin giving further information regarding the entire summer programme on spectroscopy can be obtained from Prof. G. R Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts

Institution of Electrical Engineers Awards

The following awards of premiums for papers read during the session 1934–35, or accepted for publication, have been made by the Institution of Electrical Engineers: Institution premium to N. Ashbridge, H. Bishop and B. N MacLarty; Ayrton premium to R Grierson and D Betts; Fahie premium to W. West and D. McMillan; John Hopkinson premium to W. D. Horsley, Kelvin premium to C. E. Webb and L. H Ford; Paris Exhibition (1881) premium to A. Monkhouse; Overseas premium to F. T. M. Kissel; extra premiums to Dr. T. E. Allibone, W. G. Hawley and F. R. Perry; C. Wallace Saunders, H. W. Wilson and Dr. R. G. Jakeman, E. S. Byng, C. M. Longfield; R Poole; Dr. J. C Prescott and Dr. J. E. Richardson. *Wireless Section Premiums:* Duddell premium to C F. Booth and E. J. C. Dixon; extra premiums to R H. Barfield and C. R. Burch and Dr. C. Sykes *Meter and Instrument Section Premiums:* Silvanus Thompson premium to Dr. N. H Searby; extra premium to Prof. J. T. MacGregor-Morris and J. A. Henley. *Transmission Section Premiums:* Sebastian de Ferranti premium to Dr. D. M. Robinson; extra premium to W. J. John and F. M Sayers.

Announcements

A DISCUSSION on "Supraconductivity and other Low Temperature Phenomena" will be held by the Royal Society on Thursday, May 30, at 11–1 and 2 30–4 The discussion will be opened by Prof J C McLennan. It is hoped that the following will be present and that many of them will speak Prof N Bohr (Copenhagen), Dr R De Laer Kronig (Groningen), Prof L Brillouin (Paris), Dr W Meissner (Berlin), Prof W H Keesom (Leyden), Prof W J De Haas (Leyden), Prof F Simon, Dr K Mendelssohn, Dr H London, Mr J D Bernal, Dr J. D. Cockcroft, Dr L C Jackson, Dr R Peierls There will be an open discussion during the afternoon.

DR WILLIAM E GYE, of the National Institute for Medical Research, Hampstead, has been appointed to succeed Dr. J. A. Murray as director of the Imperial Cancer Research Fund on the latter's retirement at the end of this year Dr Gye, whose publications on cancer are well known, was formerly a member of the staff of the Imperial Cancer Research Fund.

THE Fuel Research Station, East Greenwich, of the Department of Scientific and Industrial Research, will be open for the annual visitation on June 4 at 2–6 p m.

THE new solar telescope provided for Prof H H Plaskett at the University Observatory, Oxford, is to be formally opened on June 11 by the Vice-Chancellor After this ceremony, an address on "The Physics of the Sun" will be given by Sir Arthur Eddington.

THE seventh annual Haldane Memorial Lecture at Birkbeck College, London, E C 4, will be delivered by Mr C E M Joad, head of the Department of Philosophy at the College, on Wednesday, May 29, at 6 p m Mr. Joad will take as his subject "Science and Human Freedom" Admission is free, without ticket

THE trustees of the Rockefeller Foundation have promised £60,000 towards the cost of the building and equipment of the proposed Institute for the Teaching and Study of Neurology at the National Hospital for Nervous Diseases, Queen Square, Bloomsbury, London, W C 1, and a further sum of £60,000 towards the endowment for teaching and research which will have their centre in the new building.

THE admirers, friends and pupils of the late Dr. Émile Roux, director of the Institut Pasteur in Paris, have decided to establish a national fund to be known as the Roux Foundation to pay the expenses of young students of biology The general secretaries are M Sieur, Inspector-General of the French Army, and Prof Marchoux, member of the Academy of Medicine. Subscriptions should be sent to the treasurer, M. Dufaure, 205 rue de Vaugirard, Paris.

THE *Journal of South African Botany*, a new quarterly periodical, published under the authority of the Trustees of the National Botanic Gardens of South Africa and edited by R. H Compton, is designed to provide a medium for the publication of research work on the South African flora The first part (issued in January 1935) contains a systematic and historic account of the genus *Freesia* by the late N E Brown Nineteen species are described W. F Barker, T M Salter and R H Compton contribute a paper dealing with new African plants in which eight species of *Erica* and two of *Hessea* are described and illustrated

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer and demonstrator in botany and one in comparative anatomy and zoology in the University College of South Wales and Monmouthshire, Cardiff—The Registrar (May 30). An assistant lecturer in metallurgy in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (May 30) A University reader in statistics at University College, London—The Academic Registrar, University of London, S.W 7 (May 31) A lecturer in electrical engineering in the Walsall Technical College —The Director of Education, Education Office, Council House, Walsall (June 1) An assistant experimental officer (physics or electrical engineering), a technical assistant (physics and electrical engineering), and an experimental assistant at the War Department Establishment, Biggin Hill, Kent—The Superintendent (June 4) A secretary of the Royal Commission on Ancient and Historical Monuments (Scotland)—The Secretary, 27 York Place, Edinburgh, 1 (June 5). An assistant lecturer in organic chemistry at King's College, London—The Secretary (June 6). A lecturer in mechanical engineering in the Cannock Chase Mining College—The Director of Education, County Education Offices, Stafford (June 6) An assistant lecturer in geography in University College, Nottingham—The Registrar (June 6) An acting director of research to the British Launderers' Research Association—The Secretary, B L.R.A, 17, Lancaster Gate, W.2 (June 8). A professor of mining in the University College of South Wales and Monmouthshire, Cardiff—The Registrar (June 15). An assistant advisory officer in fruit growing to the Kent Education Committee—The Agricultural Adviser, Springfield, Maidstone (June 15) Two assistants (III) at the Royal Aircraft Establishment, South Farnborough (physics or engineering)—The Chief Superintendent A head of the Mechanical and Civil Engineering Department, Battersea Polytechnic, S W.11—The Principal A deputy mechanical engineer in the Egyptian State Railways Administration—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 An assistant in the Mineral Resources Department of the Imperial Institute, South Kensington, S W 7—The Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 879

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Density of Light Water: Ratio of Deuterium to Hydrogen in Rain-Water

WE have prepared light water by electrolysing natural water and burning the gases evolved The water so produced was about 100 parts in 10^7 lower in density than the natural water, on re-electrolysing this, its density was further reduced by about 14 parts in 10^7, and a third stage in the process reduced the density still further by 12 parts in 10^7 We have experimental evidence that the third stage light water is almost free from deuterium oxide, which is confirmed by a calculation of the separation obtainable under the actual conditions of the experiment These observations give, then, a difference in density at 27° C. between the third stage water and rain-water (oxidised to remove organic impurity and twice distilled) of 127 in 10^7, and imply that there is one volume (or molecule) of deuterium oxide to 8500 volumes (molecules) of hydrogen oxide in rain-water E H. and C K Ingold, H Whitaker and R Whytlaw-Gray[1] found 1 in 9000 for this ratio, and Urey[2], 1 in 5000 We find the ratio cannot readily be determined with precision because of the difficulty of purifying natural water without changing its density

In the relative density measurements, the temperature was observed at which a small fused silica float (completely immersed in the water) was in equilibrium, neither rising nor falling Platinum thermometry was used, and the average error of a determination was about 2 in 10^7, but for the light water the density during a number of distillations remained constant to 1 in 10^7. In this respect it proved strikingly different from natural water, which diminished in density each time it was distilled. When a sample of tap water was fractionally distilled, the difference in density between the first and last fractions was 200 in 10^7, showing that deuterium and hydrogen oxides can be separated by distillation and pointing to the interesting conclusion that, if precise relative determinations of the density of water which had been repeatedly distilled had been made at any time since accurate thermometry has been available, they would have disclosed the fact that natural water is not a simple substance.

W. N. CHRISTIANSEN.
R. W. CRABTREE
T. H LABY

University of Melbourne.
April 23.

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[1] NATURE, 134, 661; 1934

[2] *Rev. Mod. Phys.*, 7, 40, January 1935.

A Sensitive Polarographic Test for the Absence of Rhenium in Manganous Salts

IN 1925, the present author jointly with V. Dolejšek[1] reported on the occurrence of element No. 75 (Mendělěev's dwimanganese) in manganese salts However, the discoverers of rhenium, I. and W. Noddack[2], and others[3] expressed doubts as to whether any measurable traces of this new element could occur in manganese specimens I investigated the polarographic behaviour of potassium perrhenate and found that it is deposited at the dropping mercury cathode at the potential $-1 \cdot 2$ v from the normal calomel zero (Fig 1 Curve 2) This method is sensitive enough to show the presence of perrhenate when its concentration is 10^{-6} m in 1 m. $MnCl_2$[4] or in alkaline solutions, even if they contain tungstates or molybdates in considerable amounts

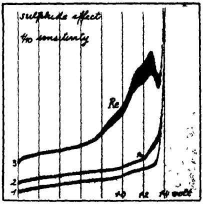

FIG 1 Polarographic curves for 1 m manganese chloride (Kahlbaum) (1) pure, (2) with 10^{-6} molar potassium perrhenate, (3) repeated after treatment with hydrogen sulphide

As the polarographic 'step' at $-1 \cdot 2$ v. is not conclusive for the presence of rhenium, so long as other elements are present which are electro-deposited at about that potential (for example, cobalt, iron, nickel, zinc), these were removed from the manganese salts by hydrogen sulphide in the presence of sodium acetate and acetic acid Some perrhenate was purposely added, which in this way could not be precipitated but merely converted into Re_2S_7 or thioperrhenate[5] Curiously enough, after this treatment an abnormal increase and shift of the perrhenate 'step' ensued (Curve 3), which was especially marked when the acidic reserve of the buffer had been enlarged by increasing the concentration of the acetate and acetic acid. Thus the perrhenate is easily detectable in a 10^{-6} m. solution; as 0·1 c.c. of the solution suffices for polarographic analysis, detection of 2×10^{-8} gm. (0·02 γ) is possible. In the absence of perrhenate, no such effect is observable, even when traces of copper, lead, cadmium, zinc, nickel, cobalt, iron, molybdate and tungstate are present. Although it is not yet ascertained that the described abnormal polarographic effect is specific for perrhenate, its lack can be taken as proof of the absence of rhenium in specimens.

Several specimens of commercial manganese salts were thus investigated polarographically as to their content of traces of rhenium. In all cases the rhenium effect was lacking, proving that commercial manganous salts contain certainly less than 1 part of rhenium per 1,000,000 of manganese, so that the steps at −1·0 v. and −1·2 v. shown on polarograms of manganous solutions (Curve 1), as well as the lines of the X-ray spectrum[1], must have been due to coinciding effects of other elements than 75.

The large current, provoked by the presence of perrhenate in the buffer solution, is probably due to the deposition of hydrogen, catalysed by a sulphide compound of rhenium[6].

J. HEYROVSKÝ.

Physical-Chemical Institute,
Charles University, Prague.
April 4.

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[1] V. Dolejšek and J. Heyrovský, NATURE, **116**, 782; 1925.
[2] W. and I. Noddack, *Z. angew. Chem.*, **40**, 250; 1927.
[3] L. C. Hurd, *J. Chem. Educ.*, **10**, 605; 1933.
[4] J. Heyrovský, *Mikrochemie*, **12**, 50; 1932.
[5] H. V. A. Briscoe, P. L. Robinson, E. M. Stoddart, *J. Chem. Soc.*, 1439; 1931. W. Feit, *Z. angew. Chem.*, **44**, 65; 1931.
[6] R. Brdička, *Biochem. Z.*, **272**, 104; 1934.

Biological Synthesis of Ascorbic Acid

IN a previous letter[1] we pointed out that the liver tissues of the rat, rabbit and pigeon are able to synthesise ascorbic acid from mannose *in vitro*, while those of the guinea pig and monkey are unable to do so. Further experiments indicate that this power is not common to all animals independent of an external supply of ascorbic acid. The liver tissues of the ox, cat and fowl, for example, cannot convert mannose into ascorbic acid *in vitro*. This might mean either that some other organs in their body are able to effect this transformation or that some entirely different means (for example, bacterial) is employed in these animals for the synthesis of the vitamin.

The *in vitro* experiments with rat tissues have now been confirmed by experiments *in vivo*. It has been found that the intravenous injection of mannose (20 mgm.) into rats is followed by a rise in the ascorbic acid content of the tissues investigated, the animals being killed 5 hours after injection. Similar injections of glucose (20 mgm.) also increase the ascorbic acid content of the adrenal gland, though less strikingly, as shown by the average figures given in the following table. Subcutaneous injection of mannose (20 mgm.) daily for three successive days also leads to a similar rise in the ascorbic acid content of the tissues.

Nature of experiment	Ascorbic acid (mgm.) formed per gm. of tissue			
	Adrenal	Small intestine	Kidney	Liver
Controls	2·53	0·26	0·17	0·18
Mannose (intravenous)	4·83	0·30	0·21	0·22
Glucose (intravenous)	3·75	0·25	0·17	0·18

Another point of interest to which we wish to refer is that in preliminary experiments we have found that embryonic guinea pig tissue at an early stage of development, ovarian tissue of the pregnant guinea pig and ovarian tissue of the adult non-pregnant monkey are also capable of converting mannose into ascorbic acid *in vitro* on incubation for 5 hours at *p*H 7·4 in a mixture of phosphate buffer and Ringer-Locke solution at 37°. This is shown in the accompanying table.

Nature of tissue	Ascorbic acid (mgm.) formed per gm. tissue
Guinea pig embryo	0·14
Ovary of the pregnant guinea pig	0·05
Ovary of the adult non-pregnant monkey	0·30

The guinea pig embryo has been found to lose this power of converting mannose into ascorbic acid gradually with its development. In these experiments carried out under the stated conditions, the replacement of mannose by glucose does not lead to an appreciable synthesis of ascorbic acid.

The above observations (especially those with the intravenous injection of glucose) indicate that while glucose is the ultimate precursor of ascorbic acid, it has probably to pass through the intermediary stage of mannose or some mannose-like configuration.

The experiments with the ovarian tissue of the monkey appear to have implications concerning the human species, while those with the guinea pig embryo seem to be interesting from the point of view of the theory of recapitulation.

B. C. GUHA.
A. R. GHOSH.

Biochemical Laboratory,
Bengal Chemical and
Pharmaceutical Works, Ltd.,
Calcutta.
April 8.

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[1] Guha and Ghosh, NATURE, **135**, 234, Feb. 9, 1935.

Estimation of Ascorbic Acid by Titration

IN the course of an investigation of the ascorbic acid content of raw and cooked Ontario foodstuffs, employing a modification of the titration procedure outlined by Birch, Harris and Ray[1], we observed that, in the case of cauliflower, carrots, parsnips, beets and potatoes, the titration value was higher in the cooked than in the raw food. This was reported in October 1934 at a meeting of the Toronto Biochemical Society[2]. Ahmad[3] has recently reported an increase in the case of cabbage, which we found to give only a decrease after heating for short periods.

We have made determinations at regular intervals when two of the above vegetables were heated under constant conditions. The increase in titration value against phenolindophenol is very rapid at first, reaching a maximum within five minutes in most cases if oxidation is retarded by the addition of cyanide, or by heating in an atmosphere of nitrogen or carbon dioxide. If oxidation is not inhibited there is not so great an increase in titration value. Following the increase there is a gradual decline as heating is continued. In the case of Ontario cauliflower, the increase is 60 per cent of the value of the raw vegetable.

It is unlikely that this increase is due to cellular disintegration as a result of heating, and consequently more thorough extraction of ascorbic acid. We were at first impressed with the likelihood of the increase being caused by the liberation of a sulphhydryl compound. However, this explanation was shown to be erroneous since colorimetric tests for cystine and cysteine are almost negative in these cooked vegetables. The character of the curves secured by plotting titration values against time of heating is such that we believe the increase is due to the setting free of bound ascorbic acid, perhaps from an ester.

In the case of certain plant tissues, then, a simple extraction and titration procedure does not give the complete value for ascorbic acid, but only measures the free acid This amount is augmented by hydrolysis caused by heating There may be present, also, an amount of reversibly oxidised ascorbic acid which is not measured by titration, unless it is first reduced by hydrogen sulphide, an observation recorded by Tillmans[4] and others. Ascorbic acid in all these forms may be biologically active, but only one can be estimated by simple titration Unlike these plant tissues, bovine adrenal tissue contains little bound ascorbic acid and none of the reversibly oxidised compound Acid fruits, such as lemons, oranges and tomatoes, resemble adrenal tissue, in containing only free ascorbic acid

E W McHENRY
M L GRAHAM

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University of Toronto
March 21

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[1] *Biochem J*, **27**, 590, 1933
[2] *Can Chem and Metallurgy*, **18**, 242, 1934
[3] *Biochem J*, **29**, 275, 1935
[4] *Z Untersuch Lebens*, **63**, 276, 1932

Extreme Infra-Red Investigation of Hindered Rotation in Water

STRONG evidence for a quasi crystalline structure in liquids has been furnished by X-ray analysis, the splitting of monochromatic light into a triplet by scattering, specific heat considerations, Raman effect[1] and by an interpretation of viscosity[2] Recently Debye[3] has succeeded in explaining several additional phenomena by assuming that not only do the molecules in a liquid vibrate under the influence of an intermolecular field about a centre of gravity which is slowly changing in space, but also that their free rotation is hindered From two independent analyses, Debye concludes that in liquid water a rotation of the dipole moment through 90° would produce a potential energy of about $10kT$

The extreme infra-red spectrum of water vapour is composed of a multitude of lines extending beyond 500μ which correspond to the combination of pure rotational frequencies about the principal axes, having for moments of inertia[4] 0 995, 1·908 and $2{\cdot}980 \times 10^{-40}$. The absorption of liquid water has been measured[5] at 108μ and 313μ and led to the verification of Debye's dispersion formula for polar molecules In Fig 1 are shown the percentage of transmission and reflection of water between 52μ and 313μ (the filled circles refer to measurements made by Rubens[6]) From these data the absorption coefficient and index of refraction were calculated. The increasing values for the absorption coefficient and index of refraction from 90μ to 313μ are in agreement with the theory of dipole moments, however, an anomalously high absorption occurs below 90μ[6]. Considering the index of refraction to be continuously rising, in agreement with the simple dipole theory, this absorption produces an anomalous dispersion between 70μ and 90μ, and is not due to internal vibrations of the water molecule (which are well known and are in the near infra-red), or to pure rotation bands (which have been measured in the vapour state throughout this region). This absorption has the appearance of a fundamental frequency and, following a suggestion of Prof. Debye's, might be due to a hindered rotation of the molecules.

Assuming the oscillations to be small and nearly harmonic, their frequency is given by $\nu = \frac{1}{2\pi}\sqrt{\frac{K}{I}}$, where K is the torsional constant and I the moment of inertia Taking ν as 140 cm $^{-1}$ (which, as might be expected, is not clearly defined) and considering rotation about the axis having a moment of inertia of $2\ 980 \times 10^{-40}$ (which would be infra-red active), the torsional constant opposing free rotation amounts to $5kT$ A frequency of 140 cm.$^{-1}$ corresponds to an energy of $0\ 7kT$, so there should be several quantum states for this hindered rotation. If we adopt the above value for the restoring torque, a hindered rotation about the axis having a moment of inertia of $0{\cdot}998 \times 10^{-40}$ (which would also be infra-red active) would have its fundamental frequency at 240 cm $^{-1}$ or 42μ This frequency lies close to the first overtone of the oscillation about the axis of greatest moment of inertia, so that especially strong absorption is expected near 40μ, but our apparatus was not suitable for measuring below 52μ.

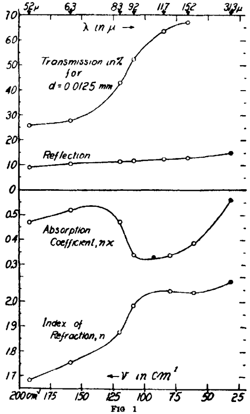

FIG 1

From our measurements, we conclude that the molecules in water are bound in a quasi-crystalline lattice and execute only partial rotation in agreement with Debye's hypothesis Free rotation is hindered by a torsional constant of approximately $5kT$, and the fundamental frequency for an oscillation about the axis of greatest moment of inertia occurs at about 140 cm.$^{-1}$ (70μ).

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[1] E. Gross and M Vuks, NATURE, **135**, 100, 1935.
[2] E N da C Andrade, *Phil. Mag.*, 17, 497, 689; 1934.
[3] P. Debye, *Phys. Z.*, **36**, 100, 193, 1935
[4] R. Mecke, *Z. Phys.*, **81**, 313, 1933.
[5] H Rubens, *Verh. d. d. phys. Ges.*, 17, 315; 1915
[6] H Rubens und E. Ladenburg, *Verh. d. d. phys. Ges.*, 11, 16; 1909

Predissociation in the Third Positive Group of CO

IN a former communication[1] we recorded the discovery of a predissociation in the upper level ($B^1\Sigma$) of the Angström bands. For the energy of the dissociation state responsible for this predissociation, we found a value of 11 08 volts above the normal state of the molecule

In their investigation of the third positive group of CO, Dieke and Mauchly[2] noticed that these bands, the common initial level of which is the O vibrational state of $b^3\Sigma$, can be traced to $K = 54$, $K = 55$, $K = 56$ for the R-, P-, and Q-lines respectively Examining the $0 \rightarrow 1$ band of this system on my own plates, it appeared to me that, at these rotational quantum numbers, a disappearance (or at least a very strong decrease in intensity) of the band lines occurs This points to a predissociation in the $b^3\Sigma$ level at $K = 55$ caused by a dissociation level with an energy of 11 08 ± 0 01 volt above the normal state This is obviously the same dissociation state as that which causes predissociation in the $B^1\Sigma$ level of the Angström bands referred to above

F BRONS

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March 2

[1] NATURE, 133, 140, 1934 *Physica*, 1, 634, 1934

[2] G H Dieke and J W Mauchly, *Phys Rev*, 43, 12, 1933

Stark Splitting of the ^6S Level of the Manganous Ion in Crystalline Fields

IN recent papers, Kramers, Bethe and Van Vleck[1] have discussed theoretically the possibility of a weak Stark splitting of the ^6S levels of Mn^{++} and Fe^{+++} ions in crystalline fields As Van Vleck has shown, such a splitting would lead to two important consequences in the magnetic behaviour of these ions in crystals: (1) it would produce a feeble magnetic anisotropy in the crystal, (2) the temperature dependence of the three principal susceptibilities of the crystal would not exactly conform to the simple Curie law The first effect, namely, the magnetic anisotropy, can be measured accurately, and can indeed be used, as Van Vleck has pointed out, as a means of calculating indirectly the magnitude of the Stark separation

Using the special experimental arrangement designed by us for measuring feeble anisotropies[2], we have recently measured the anisotropies of a number of manganous salts of the Tutton series, $MnSO_4.A_2SO_4.6H_2O$, where A = NH_4, Rb, Cs, Tl, $MnSeO_4.A_2SeO_4.6H_2O$, where A = NH_4, Rb, Tl The differences $\Delta\chi$ between the maximum and the minimum gram molecular susceptibilities of these crystals at about 25° C. range from $11{\cdot}4 \times 10^{-6}$ (C.G.S E M U.) in manganous ammonium sulphate to $7\ 0 \times 10^{-6}$ in manganous cæsium sulphate For all the crystals the mean of the three principal susceptibilities is about $14{,}000 \times 10^{-6}$

Part of this anisotropy must be attributed to that of the *diamagnetism* of the crystal. This may be taken, to a first approximation, to be the same as the anisotropy of the corresponding diamagnetic Tutton salt obtained by replacing Mn by Mg. (The anisotropies of the latter salts are found to range from $2{\cdot}5$ to $0{\cdot}9 \times 10^{-6}$) A further correction is also necessary for the anisotropy arising from the mutual influence of the magnetic moments of neighbouring Mn^{++} ions, which are not arranged in a cubic lattice

After making these corrections, we find that the residual anisotropies of the manganous salts correspond to a Stark separation of the ^6S levels of only a small fraction of a cm^{-1}

K S KRISHNAN
S BANERJEE.

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Feb 18

[1] *Phil Mag*, 17, 961, 1934

[2] *Phil Trans*, A, 232, 99, 1933.

Raman Spectrum of 1.3.Cyclohexadiene

WE published in May last year[1] an account of the Raman spectrum of 1 3 cyclohexadiene (obtained by the Harries-Willstätter method) Another method for the preparation of that compound is that of Crossley[2] However, Harries[3] first and Willstätter and Hatt[4] afterwards stated that the 1 3 cyclohexadiene prepared in accordance with Crossley's method was very impure as regards cyclohexene, bromocyclohexene and benzene On the other hand, Willstätter[4] stated that a pure 1 3 cyclohexadiene can be obtained with his method In Fig 1 we give the position of the Raman lines of the two samples of 1 3 cyclohexadiene prepared by us using these two methods

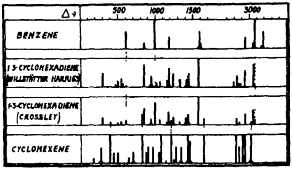

FIG 1

1.3 *cyclohexadiene* (prepared by the Harries-Willstätter's method): 292(2½), 468(0), 501(1); 553(1½); 568(½), 843(4), 940(2*b*), 1010(½); 1053(1), 1145(1½), 1171(3½*b*); 1235(2½); 1321(1½); 1408(1½*b*); 1432(2½*b*), 1574(10), 2789(1); 2829(2); 2860(½); 2879(½); 2946(3), 3051(4)

1 3.*cyclohexadiene* (prepared by Crossley's method): 292(1½), 389(½); 498(0); 548(½); 605(½); 822(2); 846(3), 940(1½*b*), 992(4); 1056(1), 1148(½), 1174(2½*b*); 1220(1); 1235(1½), 1321(½); 1408(1½*b*), 1431(2*b*), 1574(10); 1648(1½); 2827(1½); 2872(1), 2940(2), 3029(½); 3049(3), 3067(1).

It can be seen from Fig 1 (as can likewise be inferred from examination of the published values) that some of the extra lines given by the sample prepared by Crossley's method, belong to the Raman spectrum of benzene, and others to the Raman spectrum of cyclohexene. Hence Willstätter's observation is confirmed, namely, that the 1 3 cyclohexadiene when prepared by Crossley's method has many impurities, amongst which are benzene and cyclohexene.

Since the double bond line of the 1.3 cyclohexadiene is more displaced towards smaller frequencies than the known line at 1584 cm.$^{-1}$ in benzene, and since it is near the latter in spite of the enormous differences in the saturation characteristics of the two compounds, the interpretation of the line 1584 cm $^{-1}$ of benzene as being due to a double ethylenic bond in the ordinary meaning of organic chemistry would appear to be very doubtful

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[1] *Mem Acc Sci. Ist Bologna Sess*, May 27, 1934
[2] *J Chem Soc*, **85**, 1403, 1904
[3] *Ber*, **45**, 809, 1912
[4] *Ber*, **45**, 1464, 1912

Crystal Structure of some Alkali Tungsten Chlorides

About twenty years ago, O Olsson-Collenberg[1] synthesised a series of alkali tungsten chlorides with trivalent tungsten of the general formula $M_3W_2Cl_9$ Later, Collenberg and Sandved[2] found that water solutions of these compounds contain the complex ion W_2Cl_9. An X-ray analysis of these chlorides has now shown that this ion is present also in their crystals

The ammonium, potassium, rubidium, cæsium and thallium compounds are all isomorphous and crystallise in the space-group C^{3}_{6h}. The unit cell of $K_3W_2Cl_9$ has the dimensions $a = 7{\cdot}16$ A, $c = 16$ 16 A and contains two molecules Using Wyckoff's notation, the atomic positions are

2 K at 2(*a*), 6 Cl at 6(*h*), ($u_3 = 0$ 45, $v_3 = 0$ 44) 4 K at 4(*f*), ($u_1 = 0$ 31) 12 Cl at 12(*i*), ($x = 0$ 12, $y = 0{\cdot}35$, $z = 0{\cdot}16$). 4 W at 4(*f*), ($u_2 = 0$ 076)

In this structure the W_2Cl_9 groups have the configuration shown in Fig. 1 Their centra form a lattice of the close-packed hexagonal type

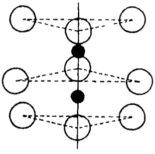

Fig. 1 Configuration of W_2Cl_9 group in $M_3W_2Cl_9$ ○, Cl, ●, W

It is of interest to compare this structure with that of $Cs_3As_2Cl_9$ recently determined by Hoard and Goldstein[3]. The latter contains no ions As_2Cl_9, and the complex arsenic chlorides seem thus to be of a different kind from the tungsten chlorides of analogous composition.

A complete report of the structure determination will be given in the immediate future, and the investigation will be extended to embrace also the tungsten chlorides with metal–ammonia and partly organic cations

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March 1.

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[1] Thesis, Uppsala, 1914.
[2] *Z. anorg allg. Chemie*, **130**, 1, 1923.
[3] *J Chem. Phys.*, **3**, 117, 1935.

The Spinels and the Cubic Sodium-Tungsten Bronzes as New Examples of Structures with Vacant Lattice Points

X-ray studies, carried out in this Institute, have shown that when the spinel, $MgO.Al_2O_3$, dissolves Al_2O_3, the oxygen excess is caused by the occurrence of vacant points in the metal lattices In accordance with this, γ-Al_2O_3, the unstable limit of these solid solutions, represents a spinel lattice where 1/9 of the metal positions are vacant.

In the same way it has been shown that when Fe_3O_4 is oxidised to γ Fe_2O_3, this process is accompanied by the occurrence of vacant points in the Fe lattice so that only 8/9 of them are occupied in γ-Fe_2O_3 At the same time the lattice dimensions decrease The presence of vacant points has been definitely shown by measurements of both the intensities of the interferences and the densities of the preparations

The general formula of the sodium-tungsten bronzes has been shown to be Na_xWO_3 In the gold yellow bronze, x is 1 and the cube edge = 3·850 A. This bronze contains W^{+5} ions and crystallises in a complete perowskite lattice. The deepening of the colour from yellow through red to blue is accompanied by a continual decrease in sodium content and dimensions With decreasing values of x, vacant points occur in the original Na lattice and in the blue bronze ($x = 0$ 3–0 4, $a = 3{\cdot}813$ A), about two thirds of the original Na positions are empty. At the same time, W^{+6} ions occur and the increasing amount of these ions is probably the cause of the deepening of the colour

The above 'subtraction phases' represent, quite as much as the 'addition' or 'interstitial' phases, solid solutions with a variable number of atoms per unit cell It is a mere matter of convenience if such a phase is termed a 'subtraction' or an 'addition' phase In all cases where a variable number of atoms has been found, the structure is built up by large atoms or ions (in most cases anions, and especially oxygen ions). The atoms, which vary in number, are always comparatively small and placed in the interstices of the skeleton formed by the large atoms. A variation of their number is possible if the structure is of a non-polar type (hydrides, carbides, nitrides of many transition elements), if ions are substituted by other ions with another charge ($MgO\,Al_2O_3 \rightarrow \gamma$-$Al_2O_3$, tremolite → hornblende, β-cristobalite → α-carnegieite, $AgI \rightarrow Ag_2HgI_4$), or if the lattice contains ions which are able to change their charge (especially in lattices containing transition elements, for example, $Fe_3O_4 \rightarrow \gamma$-$Fe_2O_3$, the cubic Na-W-bronzes)

More detailed reports of these investigations will be published elsewhere

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Feb 28.

Bio-Electric Transients during Fertilisation

In 1909 R. S Lillie[1] suggested that the activation of the unfertilised egg by a spermatozoon or by a parthenogenetic agent might involve the temporary depolarisation of the cell surface, the process being similar to that observed in stimulated nerve or muscle. This so-called 'physical' theory of fertilisation and parthenogenesis has been elaborated by Gray[2], who differs from Lillie in considering that there is no recovery after the depolarisation as there is in nerve, muscle and certain plant cells Confirmatory evidence of this has been produced by Gray[2], who has shown that fertilised sea-urchin eggs have a higher conductivity than unfertilised eggs (These results have recently been criticised on theoretical grounds by Cole[4])

One of us (V R.)[5] has shown that the activation of the unfertilised frog's egg by trauma is associated with the propagation of an action potential over the egg surface. The action potential differs from that found in nerve or muscle in that there is no recovery phase.

We have continued these experiments, substituting a spermatozoon for the micro needle Two electrodes held in two Péterfi[6] micro-manipulators were placed at opposite poles of the animal pole of the frog's egg, localised fertilisation near one (grid) electrode was effected by means of a micro pipette filled with sperm held in another Peterfi micro-manipulator The electrodes were connected to a Matthews[7] oscillograph used in conjunction with resistance capacity-coupled amplification

There are strong indications that the attachment of the spermatozoon to the egg results in an action potential being propagated over the egg surface, the action potential again being characterised by having no recovery phase The change is considerably slower than that observed in stimulated nerve or muscle, and for this reason capacity coupled amplification is unsatisfactory, as the rate of discharge of the coupling condensers is great compared with the rate of change of the action potential Considerable distortion is therefore inevitable

We propose to continue these experiments during the next frog-breeding season using battery coupled amplification in order to obtain quantitative data

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March 25

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[1] R S Lillie, *Biol Bull*, 17, 188 1909
[2] J Gray, *Quart J Mic Sci*, 66, 419 1922
[3] J Gray *Phil Trans Roy Soc*, B, 207, 481, 1916
[4] K S Cole, *J Gen Physiol*, 12, 37, 1928
[5] To be published in the near future
[6] T Péterfi, 'Handb Biol Arbeitsmeth (Abderhalden), 5 479, 1923
[7] B H C Matthews, *J Physiol*, 65, 225, 1928

Response of the Leech to Acetylcholine

THE work of Dale, Feldberg and others shows in a striking way that, in the Vertebrata, excitation is transmitted from nerve to effector through the mediation of either acetylcholine or of adrenalin, according to the mode of innervation[1] A sensitive test employed for the presence of acetylcholine is its power to cause contraction of the longitudinal muscle of the body-wall of the leech *Hirudo medicinalis* I wish to direct attention to the fact that this sensitivity of leech muscle completes a very remarkable picture disclosed by J F. Gaskell[2]

In the leech and other annelids, the nervous control of the vascular and the 'voluntary' muscular systems shows a detailed parallelism to these same systems in the Vertebrata. In *Hirudo*, the contractile blood-vessels receive a double innervation of accelerator and depressor nerves which modify their rhythm Adrenalin accelerates the rhythm, and the central nervous system contains chromaffine cells analogous to those of the vertebrate sympathetic. In the same way, the vago-mimetic drug muscarin depresses the rhythm, and this action is antagonised by atropine.

The longitudinal and circular muscles of the body-wall do not respond to adrenalin, and can be paralysed by curare This evident parallel to vertebrate skeletal muscle is now completed by the responsiveness of the muscle to acetylcholine

A physiological similarity of such intricacy between members of such distant phyla as the Vertebrata and the Annelida is most impressive It seems possible that 'cholinergic' and 'adrenergic' transmission of excitation demonstrated in vertebrates may be widespread among the cœlomate phyla, a view supported by the general similarity of action of adrenalin and other drugs among different animals

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April 26

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[1] Dale, H, *Brit Med J*, 29, 3827, 1934
[2] *Phil Trans Roy Soc*, B, 205, 153, 1914

A Tame Platypus

MORE than a year ago I recorded the successful rearing of a platypus by Mr R Eadie at Healesville, Victoria[1], the animal has now been in captivity 740 days It was probably five months old when captured, and was then 15 inches long and weighed 48 ounces avoirdupois It is now 21 inches long and weighs 72 ounces Its daily diet is 18 ounces of worms and two eggs, specially prepared During the period of captivity it has consumed 700 pounds of worms and 1,300 eggs, most of them duck eggs. It has also eaten thousands of tadpoles and large quantities of grubs. Whether this is a balanced diet or whether in the wild state it finds something else to eat remains to be investigated But the success of the experiment so far seems unique

It is still more satisfactory to note that, owing to the protection given and the interest taken, the platypus in the streams appear to be increasing in number. Mr Lewis, chief inspector of fisheries and game, is to be congratulated on the effective protection afforded

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Feb 25

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[1] NATURE, 132, 446, 1933 133, 260, 1934

Sounds Made by Fishes in the East Indies

I WAS interested to read the notes on this subject in NATURE of November 17, 1934, and March 16, 1935

Although I have not heard the sound made by *Therapon*, whilst collecting in Singapore waters some years ago I was introduced to a similar phenomenon caused by fishes of the family *Sciænidæ* (probably of the genus *Otolithus*) The Malay name of these fishes is *gĕlama*. The first time I heard these sounds I was in the company of Mr W Birtwistle, of the Malayan Fisheries. The best results were obtained by applying the ear to the rail of the launch The sounds might be described as a 'chirping' or intermittent hum

Mr C Boden Kloss, until recently Director of Museums in Malaya, writes (*in litt.*) of a similar experience off Batticaloa in Ceylon He refers to the sound as "piping . something like the note of the Singapore bull-frog made fluty and musical"

The name given by the Malays to some fishes of the genera *Therapon* and *Centrogenys* is *kĕrong-kĕrong*, *mĕnkerong* or *tĕnkerong*[1]

Dr. C. O Blagden, of the School of Oriental Studies, tells me that the meaning of *kĕrong* is a deep metallic or booming sound, and agrees with my suggestion that it is of onomatopœic origin. This would account for the Malay name of Dr Hardenberg's fish, and show that the phenomenon is known to the natives (I have not been able to see a copy of Dr Hardenberg's paper so do not know whether he has discussed this)

On the east coast of the Peninsula the Malay fishermen employ a *juru sĕlam* (literally 'diving expert', *fide* Dr Blagden) He dives under the surface, listens for the fishes, and is said to be capable of guiding the boats. His activities (an account of which appears in a report by Mr Birtwistle issued, if memory serves, about 1928) have been looked upon with a tolerant incredulity by Europeans in Malaya In view of the above, however, it appears that they may have at least a basis of fact

NORMAN SMEDLEY.

Art Gallery and Museum,
Waterdale, Doncaster
April 8

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[1] Maxwell, C N, *J Straits Branch Roy Asiat Soc*, No 84.

Activation of Cambial Growth by Pure Hormones

IN a recent letter to NATURE[1] it was reported that strong cambial growth can be activated in young decapitated sun-flower seedlings by inserting their upper ends into tubes containing a weak solution in gelatine of the ether-soluble component of urine With a similar method it has now been found that strong cambial growth can be activated by solutions of pure auxin *a* and of pure β-indolyl-acetic acid (called by Kögl[2] 'hetero-auxin') at concentrations of 1 or 2 in 10^6. The auxin-*a* was kindly sent by Prof Kögl from Utrecht, and the hetero auxin was kindly synthesised by Dr Weisberger at the Dyson Perrins Laboratory, Oxford The cambium formed was in the normal position, and it extended for at least three centimetres below the part to which the hormone was applied Controls had formed no cambium, or scarcely any

Thus the same hormones, auxin *a* and hetero-auxin, which promote the elongation of stems and coleoptiles, also activate growth in thickness by divisions of cambial cells, besides activating root-formation[3,4] and producing various other effects. According to Kögl[2], auxin-*a* is the hormone formed by the tips of grass seedlings, whereas hetero-auxin is formed by yeast. For experiments on growth, the use of pure hetero-auxin, which can be synthesised in ample quantities, should prove very valuable.

R. SNOW.

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[1] Snow and Le Fanu, NATURE, 135, 149, Jan 26, 1935

[2] Kögl, *Ber deutsch. chem Ges*, 68, 16, 1935

[3] Thimann and Went, *Proc Kon. Akad Wetensch Amsterdam*, 37, 456, 1934.

[4] Thimann and Koepfli, NATURE, 135, 101, Jan. 19, 1935

Tetraploid Sweet Peas

Lathyrus odoratus has been classical material for genetic study ever since the rediscovery of Mendel's work But up to now, no chromosomal aberrations of any kind have ever been found. The sweet pea, in common with all other species of *Lathyrus* hitherto investigated, has seven regular bivalents at meiosis It is therefore of interest to report here the first discovery of tetraploidy in this plant

In a family growing at this Institution, Miss C Pellew noticed a plant with constricted pods, such as are typical of the half-sterile heterozygous translocation plants in *Pisum* The plant was very vigorous and set a large number of pods which, however, contained but few seeds—never more than four, instead of the usual 8–12 Owing to the lateness of the season, no preparations of pollen mother-cell divisions could be made, but mitoses were found in petals and sepals which showed the plant to be tetraploid The root-tips of ten seedlings obtained by selfing this plant were examined cytologically, and in every case a complement of 28 chromosomes was found

The family in which the tetraploid plant appeared was an F_2 segregating for four recessive factors copper, acacia, glabrous and dull—the last three being in one linkage group The tetraploid plant was dominant for all four genes, it is thus not improbable that some factors will be available for the study of tetrasomic segregation in sweet peas.

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March 29

Inhalation of Carbon Dioxide at High Altitudes

THE suggestion put forward in NATURE of March 23 (p 457) by Prof Yandell Henderson and others to the effect that carbon dioxide might be of use in high altitude climbing reminds me of some trials carried out about ten years ago. Messrs Siebe Gorman and Co., Ltd, had similar ideas, and they lent me a rebreathing mask to try out in the Alps I went up to the Margherita hut on Monte Rosa, to all intents 15,000 ft, to test it I was in fairly good training at the time, but had not been above about 12,000 ft that summer For trial purposes this was all to the good, as I became rather blown during the last thousand feet, having walked up fast to the 14,000 ft level It may therefore be assumed that I was partially but not fully acclimatised.

The moment I started to rest at the hut I felt perfectly fit, and after lunch I lay down for 20 minutes or so, before starting the test I then noted pulse and respiration rates, put on the mask and noted them again. I have not a record of the figures handy, but can definitely state from memory that there was an almost immediate drop of 20–25 per cent in each rate

I am afraid I did not try the mask while walking uphill; but a device which weighs fewer ounces than a gas bottle weighs pounds might be worth thinking seriously about On the other hand, it is quite possible that it might defeat its own object, by supplying carbon dioxide at the expense of oxygen However, the experiment is so simple that it should be tried while going uphill, care being taken to adjust the capacity of the mask so that the most advantageous volume of air is rebreathed. The mask I used was adjustable in this respect. The mask should be so designed that the capacity can be recorded. Mine was not, and I probably opened it about half way and chanced the result.

Incidentally, I might record the experiences of two well known British climbers I think during the same summer. One had the idea that carbon dioxide was the solution of the high altitude problem, got some bombs charged with it and persuaded his friend to come and test them on Monte Rosa. The proposal was to test them before becoming acclimatised, and so they travelled out to the Alps and straight away crossed Monte Rosa to the Margherita hut. On arrival there they were so done that they had to receive medical attention and were glad to get down with the bombs untested. One was laid up for a week afterwards. This agrees with Prof. Henderson's note about the two men who had walked up Pike's Peak without getting into condition first of all.

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Control of Dunes

THE arid south-east corner of the Mediterranean basin has been desolated by sand dunes increasing during the last few centuries and ever smothering more and more of a fertile border of Sinai and Palestine. The means for control can be seen in existing vegetation.

Examination of irregular palm groves shows that a belt three palms wide, about 80 ft., entirely arrests dune advance, by acting as a friction clutch on the upper wind beneath which the ground flow of sand haze cannot be formed. Eventually a dune may pile up until it slides down and covers the front palm stems but the tops still keep a wind clutch. Pockets of palm grove become enclosed when dunes flow on both sides, but they still maintain a clear ground beneath covered with small plants. A gap of 100 ft. in a belt lets a dune through, and even 50 ft. is precarious.

Besides arresting the front of dunes by palms, the gathering ground behind can be checked by lines of *Opuntia*, which will grow on the sand. Such a line will hold up 10 ft. depth of sand, growing up as the sand rises. Though dangerous in unoccupied Australia, there is in Palestine such a pressure of occupation that there is full control. Fig is useful to stop ground flow, but does not grow unless some organic soil is within reach of the roots.

FLINDERS PETRIE

Zuweyd, Sinai, Egypt.

A Sine Curve Crack in Natural Ice

IN January of this year, an interesting phenomenon was observed on Lake Bohinj in the Julian Alps. This lake, in the extreme north west of Yugoslavia is a typical alpine lake, its basin having been hollowed out by a diluvial glacier. Its altitude is 523 m.; it is about 4 km. long and 1 km. wide. In winter the lake is thickly frozen over and last winter was no exception. Acute tangential tensions always set up in the ice crust and find adjustment in various cracks which extend over the entire width of the lake in straight or broken lines, as the case may be. As a rule the cracking of the ice is accompanied by a powerful detonation which can be heard distinctly for a distance of several kilometres.

On January 4 Mr. F. Avčin noticed a peculiar crack in the ice. It extended across the entire lake and was about one kilometre in length. Near the southern shore its course was curved and then followed a straight line to the opposite shore. The crack itself however was in the form of an almost perfect sine curve (Fig. 1). The wave-length of this curve was about three metres, its amplitude about 0.5 m. The ice was about 15 cm. thick. The crack was about 10 cm. wide and on January 4 a thin crust of new ice had already formed upon it. There were several other cracks in the ice but all of them normal, that is, straight. They too were newly frozen over and therefore appeared to be of the same age as the sine curve crack.

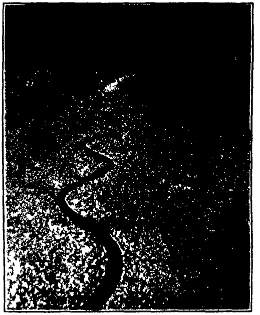

FIG. 1. Sine curve crack in the ice of Lake Bohinj.

It is suggested that the detonation caused by the occurrence of one of the normal cracks liberated the tensions in the sine curve crack. The percussion started by the cracking of the ice travelled through the ice in the form of longitudinal vibrations. Periodically alternating condensations and attenuations passed across the crack as it was being formed in a straight line. Might not the combination of these two phenomena furnish the explanation of the sine curve track of the crack? I am indebted to Mr. F. Avčin for the photograph and description of this strange phenomenon.

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Davy's Experiments on the Frictional Development of Heat

IN NATURE for March 9, 1935 (p 359), Prof Andrade directed attention to the persistent text book errors concerning Davy's experiments on the frictional development of heat, pointing out, among other things, that the much quoted experiment on the melting of two pieces of ice by rubbing them together was not carried out in a vacuum It may be of some interest to inquire how Davy produced and maintained the vacuum for the first experiment, in which a gunlock was fired, and for the third experiment, in which wax was melted by the heat developed by the friction of a wheel rotated by clock work against the plate carrying the wax Davy gives no details of his vacuum apparatus, but refers to the "exhausted receiver" of an "air pump" In the first experiment the trigger of the gunlock was snapped, he says, by this means "A slight iron wire was affixed to the trigger, brought through a hole made in the centre of the stand [supporting the receiver], and cemented into the hole with wax, so as to exclude entirely atmospheric air from the receiver"[1] Presumably the same device was used in the third experiment to start the clockwork

In neither case would a vacuum be maintained As for the apparatus by which the vacuum was produced, it appears to have been an 'air pump' with a curious history, indeed, a curiosity itself Davy had shown some kindness to the surgeon of a French ship wrecked at the Land's End, and in return the latter gave him certain instruments, including a glyster or enema syringe, which Davy converted in some way or other into an air pump This account is given by Paris[2], who states that he obtained it from Thomas Giddy of Penzance John Davy, however, in writing his brother's biography, discredited Paris's story of the syringe, alleging that "Mr Giddy probably had it from some facetious person who wished to amuse him . because no one belonging to our family ever heard of this instrument, or of the French surgeon, or of the shipwrecked French vessel off the Land's End, so circumstantially noticed in Dr Paris's lively narrative"[3] While Paris's account is reasonably credible in view of the scant facilities likely to be available to a youth of nineteen in such a remote part of the country as Penzance, John Davy's denial is not improbably due to his extensive irritation with Paris's Stracheyan sense of a biographer's duties

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[1] "Contributions to Physical and Medical Knowledge", etc, ed Thomas Beddoes, Bristol, 1799, p 9

[2] "Life of Sir Humphry Davy", London, 1831, I, pp 41-2

[3] "Memoirs of the Life of Sir Humphry Davy", London, 1836, I, pp 43-4

Identity of Calycopterin and Thapsin

A YELLOW colouring matter with powerful anthelminthic properties has recently been isolated[1] from the leaves of *Calycopteris floribunda*, Lamk., and the constitution of a dihydroxytetramethoxyflavone ascribed to it. Since it yielded *p*-hydroxybenzoic acid by degradation with alkali, it became obvious that all the six positions of the fused benzene ring were occupied and the substance was a remarkable instance of a pentahydroxybenzene derivative occurring in Nature Demethylation gave a new hexahydroxyflavone, 'calycopteretin'.

While this work was going on, one of us[2] obtained a by-product, thapsin, in the preparation of digitoxin from a dried and powdered specimen of the leaves of a Spanish *Digitalis*, the botanical source of which was uncertain, but was very probably derived from *Digitalis thapsi*, L The independently described properties of calycopterin and thapsin are very *similar and direct comparison of the two* substances and their dimethyl ethers has shown their complete identity The occurrence of a flavone with so unusual an orientation of hydroxyl and methoxyl groups in two plants belonging to widely different natural orders (one to the Combretaceæ and the other to the Scrophulariaceæ) is worth notice

With regard to the slight precedence in point of time, we suggest that the name calycopterin may be retained for the flavone constituents of both *Calycopteris floribunda* and *Digitalis thapsi*

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[1] Ratnagiriswaran, Sehra and Venkataraman, *Biochem. J*, 28, 1964 1934

[2] Karrer, *Helv Chim Acta*, 17, 1560, 1934

Philosophical Interpretation of Science

WHILE it is true that Prof Dingle[1] and I can finish this discussion in private, it seems to me there is a public importance in differentiating the two schools of thought One school claims that science is an historical phenomenon produced by human beings in their handling of the world of which they are parts, a social practice with technological, experimental and theoretical aspects all interlocking and interdependent Scientists it sees as individuals consciously or unconsciously fulfilling the social purpose of science even when they are personally interested only in developing its logical framework I agree with that view of science

There is the other school that sees science simply as the organisation of our experiences in logical form Prof Dingle even goes further than this for he asserts that "the logical network *is* the external world", and he believes this to be a consequence of scientific discovery It was this to which I took exception, and I doubt whether either Einstein or Bohr, whom he has quoted in support, would underwrite this Be that as it may, the first view sees science in its social context, sees it socially conditioned, and keeps the scientist alive to the social consequences of his work The second view banishes the world into a set of logical ideas. The first view says that science and philosophies are produced by man, are manifestations of his social behaviour and therefore exist with him in the external world. The second view leads Prof Dingle to say "It certainly never occurred to me to claim that the external world contained philosophies". The two schools evidently speak different languages

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[1] NATURE, 135, 793, May 11, 1935

Nova Herculis, 1934

AFTER dropping in brightness at the end of April to about mag. 13, this star has brightened markedly again. A spectrogram secured by an 8-hours exposure spread over two nights, May 17–19 (with the star's magnitude at 10·6^m–10·2^m) shows a complete change of spectrum. The lines of Fe II and [Fe II] have vanished, and the lines of [O I] are much weaker. The hydrogen lines are stronger again and N II, [N II] and He II are all represented. The strongest lines are now the well known nebular lines of [O III] at 5007, 4959 and 4363. At an earlier stage (late in March) bright bands appearing simultaneously at 4360, 5006 were identified as [O III] lines. As the changing spectrum developed, it became clear that these bands were due to [Fe II] and N II respectively. The presence of a bright line at 4959 and the absence of [Fe II] show that the [O III] lines are now present. This transformation to the spectrum of a planetary nebula and nucleus is typical of novæ.

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May 19.

Points from Foregoing Letters

BY successive electrolysis of water and the recombination of the hydrogen and oxygen, Messrs. W. N. Christiansen, R. W. Crabtree and Prof. T. H. Laby have obtained 'light' water free from the heavy variety, and find the density to be 12·7 parts per million less than that of ordinary water. The authors remark that the partial separation of 'heavy' and 'light' water which takes place during distillation produces a noticeable difference in the density of the first and last portions of fractionally distilled water.

New polarographic tests, depending upon the polarisation produced at a dropping mercury electrode in contact with solutions containing compounds of manganese and of rhenium, have convinced Prof. J. Heyrovský that the effects which he and Mr. V. Dolejšek had previously attributed to the presence of rhenium in commercial manganese salts are really due to other impurities.

Injection of mannose into rats leads to an increase in the content of anti-scorbutic vitamin (ascorbic acid) in some of their tissues, according to Messrs. B. C. Guha and A. R. Ghosh. The ovarian tissues of the pregnant guinea pig and the guinea pig embryo as well as the ovary of an adult non-pregnant monkey were also found capable of converting mannose into ascorbic acid *in vitro*.

The amount of ascorbic acid found by titration in certain vegetables is greater after boiling or treating with hydrogen sulphide. Messrs. E. W. McHenry and M. L. Graham infer that ascorbic acid may exist in these vegetables in three forms: free, combined as an ester, and oxidised. Only the first form is estimated when these vegetables are extracted with trichloracetic acid, and the extract titrated against phenolindophenol indicator.

Mr. C. H. Cartwright finds that water has an anomalously high absorption for infra-red radiation of wave-lengths just below 90μ and he deduces, in accordance with Debye's hypothesis, that the molecules in water are bound in a quasi-crystalline lattice and execute only partial rotation.

From measurements of the anisotropic magnetic susceptibilities of manganous salts, after allowing for the diamagnetism of the crystals, Messrs. K. S. Krishnan and S. Banerjee conclude that only a small Stark effect (splitting of spectrum lines or radiation quanta in an electric field) may be expected in the ^6S level of the manganous ion, in the crystalline field.

Results of analysis of light scattered by 1.3 cyclohexadiene, a substance related to the terpenes, constituents of many ethereal oils, obtained by Messrs. G. B. Bonino and R. M. Ansidei, confirm that, when the compound is prepared by Crossley's method, it contains various impurities, among which are benzene and cyclohexene.

X-ray analyses of crystalline alkali tungsten chlorides of the general formula $M_3W_2Cl_9$ show that the complex ion W_2Cl_9, found in their solutions, is also present in the crystals. Mr. C. Brosset gives the crystallographic constants of $K_3W_2Cl_9$ and points out that the corresponding arsenic compound $Cs_3As_2Cl_9$ contains no As_2Cl_9 ions.

Messrs. T. Péterfi and V. Rothschild report that when a spermatozoon attaches itself to the frog's egg in the process of fertilisation there are indications of an electrical change (action potential) propagated over the egg surface. V. Rothschild had previously observed that when the unfertilised egg is 'activated' by pricking, a similar action potential is propagated.

Mr. C. F. A. Pantin directs attention to the fact that acetylcholine, adrenalin and other drugs act upon the nerve and the muscle cells of the leech in the same way as they do upon corresponding cells of the higher animals.

Further evidence that the hormones auxin-*a* and hetero-auxin activate growth in thickness of decapitated sunflower seedlings, by increased division of cells of the cambium, is adduced by Mr. R. Snow. The same hormones are known to promote the elongation of stems and of germ-sheathes of grasses, and to activate root formation, etc. Auxin *a* has been obtained from the tips of grass seedlings and hetero-auxin from yeast, and they have also been prepared synthetically.

The occurrence of a sweet-pea mutation with double the normal number of chromosomes is reported by Mr. A. C. Fabergé, who describes some of the characters of the new variety.

Mr. P. J. H. Unna describes his own and two other climbers' experiences while attempting to test the suggestion that inhalation of carbon dioxide might be useful in high altitude climbing.

Sir Flinders Petrie indicates the conditions under which the palm tree and the prickly pear cactus (*Opuntia*) are useful in preventing the advance of dunes in Sinai and Palestine.

Calycopterin and thapsin, the former (a vermifuge) obtained from the leaves of the climbing Indian plant *Calycopteris floribunda*, and the latter obtained from Spanish fox-glove, are chemically identical. Mr. W. Karrer of Basle and Mr. K. Venkataraman of Bombay, who originally described the properties of these two substances separately, now announce their identity in a joint letter.

Research Items

Early Man in Uganda. Mr E J Wayland, as a preliminary to a Geological Survey Memoir to be published in the course of the current year, has summarised in chronological order the main features of his studies in Uganda since 1919 with reference to its prehistory (*J Roy Anthrop Inst*, **64**, Pt 2). The prehistory of a country is no longer merely a question of culture sequences and human types, but has now been enlarged to include the physical conditions, their changes and the effects of these on human activities. In Uganda there were not only great changes of climate during Pleistocene days, but also of topography and hydrography, consequent upon powerful earth-movements, of which the Rift Valley and Victoria Nyanza are two visible expressions. Two pluvials are claimed in the Pleistocene and in each of them is an intrapluvial period, while the post pluvial period is punctuated by two spells of moister climate. They are separated by a relatively dry break and preceded by a more pronounced swing towards aridity. Earth movements are recorded at three points, to the most recent of which the present configuration of the Rift Valley and the lake and the flow-direction of the river system are due. Equated with these events of the Pleistocene are Stone Age cultures. With Pluvial I are associated Early and Later Kafuan. In the following interpluvial, lakes dry up. The early part of Pluvial II is associated with Pre-Chellean and Protosangoan, followed by Chelleo-Acheulean and Early Sangoan. It is correlated tentatively with Riss. An intrapluvial follows associated with Acheulean, a valley culture, and Full Sangoan, a hill culture. Pluvial II, correlated with Wurm, is associated with Mousterian and Lower Aurignacian, followed by Still Bay and Upper Aurignacian, respectively. The Aurignacian has the appearance of a foreign origin, presumably from the north or north east. From the Aurignacian arise microlithic industries, such as Magosian and Wilton, a dying Still Bay influence being discernible in the former. These are post pluvial and are correlated tentatively with the Achen retreat and Bühl stadium. In Uganda, pottery appears first with Wilton.

Polynesian Mythology. A number of legends concerning Maui and Tahaki, the former the central figure of Polynesian mythology, from the island of Fagatau of the Tiamotu Archipelago, are published with a translation by J F Stimson (Bull 127, Bernice P. Bishop Museum, Honolulu). The legends of Mauri and Tahaki are found throughout Polynesia, the well-known legend of Maui being one of the most widespread of the pre-distribution myths. The principal Tahaki theme, the voyage to the underworld to avenge Hema, is fairly consistent throughout Polynesia, but the incidents composing the plot differ markedly in different localities. The material now published is derived from the narration of Farua-a-Makitua, a former chief of Fagatau and inheritor of the esoteric lore of Kamake, the greatest of all Tuamotuan sages. His wife Reva refused to receive the ancient teaching of Kamake as being "heathenish nonsense" and her version of the legends is not included as probably being affected by Christian influence. Chants are interspersed throughout the narrative. These are mostly of an erotic character, and have been included only when they form an integral element in the progression of the myth. The music of these chants, as sung by Reva, has been analysed by E G Burrows. Verbal rhythm dominates the musical rhythm (the contrary of European song) and a further irregularity is due to the pauses. The accent corresponds to $\frac{4}{4}$ time in European notation. The simple irregular rhythm of the chants, their narrow tonal range and prevailing monotone, and the quavering endings are widespread, and presumably ancient, in Polynesia.

Hair-Tracks of Australian Aboriginals. A detailed account of the lie of hair upon the bodies of Australian aboriginals, made by Dr J H Gray, suggests that the hair-tracks are highly characteristic of the race, and that they constitute a striking departure from the human hair pattern hitherto accepted as normal (*J Anat*, **69**, 206, 1935). The differences are connected with the presence of centripetal hair-whorls on jaw and back, and reversals of the normal hair trend on the posterior of the thigh and on the back. Dr Gray is inclined to correlate the peculiar reversals with characteristic habits peculiar to the aborigines. The dorsal reversal he associates with gravitational and other forces involved in the maternal carriage of children upon the left hip, and the anti clockwise spiral with the support given by the mother's left arm while the child is being carried. The disturbances of pattern upon the posterior aspect of the thigh he thinks may be brought about by the squatting habits of the aboriginals. In the fœtus, the descriptions so far made have indicated no departure from the normal in the hair-tracks. But before the idea can be accepted that habits alone can produce in each generation uniform and characteristic hair-patterns, more would have to be known regarding the hair tracks in other primitive races.

Spines of a Spinous Rat. Specimens of the spinous rat of Amami (*Rattus jerdoni osimensis*, Abe) have been examined by Yosio Abe, particularly as regards the curious spines which project beyond the normal fur (*J Sci. Hiroshima Univ*, **3**, 107, Dec 1934). Contrary to what has been suggested as regards the spines of other species, these do not appear to be shed in winter, nor are they noticeably fewer in younger animals. Their arrangement in the skin shows that they correspond in a hair group to a *Mittelhaare*, and this indeed may be a spine in some groups, and in others an ordinary overhair. A tendency in one direction or the other means the difference between a richly-spined and a poorly-spined individual. In transverse section the spines are flattened and strongly curved in at the sides, and although at their place of origin they contain a well-developed medulla, the subsequent constriction has the effect of restricting the medulla to the thickened edges.

Some Laurentian Copepods. Prof. Arthur Willey has recently discussed the variations of certain copepods which are of much interest (*Trans Roy. Canad. Inst*, **20**, Part 1, 1934). In a letter to NATURE of August 8, 1925, he briefly described a new copepod *Canthocamptus hiatus* from a swamp beside the Nikaban

River. This species has now been found again in water accumulating in the funnel-shaped leaves of the pitcher plant, *Sarracenia purpurea*, in Quebec. The fifth foot is peculiar in having only five marginal bristles instead of the usual six and is distinguished as the *forma urceolicola*, the more northerly form being the *forma paludicola*. It is made the type of the new sub-genus *Pentacamptus*. Each form is found associated with a different species of *Cyclops*. Several more species of *Canthocamptus* are re-described and variations noted. There is a general similarity in the nature of the variation, and at the same time some parallelism as well as mere identity between European and trans-Atlantic species and races. In *Cyclops vernalis* and *C. venustus* the variations are of different kinds, although the species are fairly closely allied and live together in a small space under identical conditions. They were found in a small spring in almost pure culture when the rest of the countryside was covered with a thick mantle of snow and ice in the foothills of the Laurentians. A single ovigerous female of the rare *Cyclops modestus* was found in water poured from the submerged introrse leaves of the yellow water lily.

Penæidæ of Louisiana. Mr Martin D. Burkenroad has continued his studies on penæids (*Bull. Amer. Mus. Nat. Hist.*, **68**, 1934), a companion paper having appeared a few months ago (Bingham Oceanographic Collection, **4**, 7, 1934). The present investigation is mainly confined to the eastern portion of Louisiana, and the material is estuarine and littoral. It is very satisfactory that the importance of the larval history is realised. The classification is thus based on the structure of both adult and larva. Four sub-families of the Penæidæ are recognised and these are discussed particularly in the light of larval history. The Aristæinæ and Solenocerinæ show close affinities and are contrasted with a second group composed of Penæinæ and Eusicyoninæ. All the descriptions are detailed, and great care has been taken in the examination of all essential characters. It is interesting that the author is of the opinion that in all Penæidæ the pleurobranchs are the last gills to appear in larval development. He finds that "postmysis larvæ of Penæinæ completely lack pleurobranchs and are indistinguishable in this from larval Eusicyoninæ; in the further course of development, the Penæinæ add pleurobranchs to somites behind VIII and IX, as well as to those somites, while the Eusicyoninæ do not develop them behind IX".

Bryozoan Fauna of the Faroes. Until the present, records of Bryozoa from the Faroe Islands have been extremely few. This gap in our faunistic knowledge of this region has now been filled by the publication of a hand list of the Bryozoa of these islands ("Zoology of the Faroes". Section 58. Bryozoa) compiled by P. L. Kramp. The list comprises 82 species all from the Faroe plateau proper—that is, within the 200 metre line and the Faroe Bank. The list is followed by a brief discussion of the bryozoan fauna of the Faroes from a zoo-geographical point of view.

Diagnostic Characters of Woods. In various countries now, attention is being paid to the possibility of distinguishing between the woods of different tree species with a much greater appreciation of the difficulties created by the range of diversity in structure within a species. The difficulty is greater with softwoods where the structural element composing the wood is so uniform, and Mlle. M. Brem (*Bull. Internat. de l'Acad. Polonaise Sci. Nat.*, 1934) has recently tested, on larch and spruce, the method suggested by Dr. J. A. Stamm (*Bot. Gaz.*, **92**, 1931). Dr. Stamm counted the number of intersections of double tracheid walls, compared with tracheid ray walls met with along a series of horizontal planes in tangential longitudinal sections of the wood. The ratio thus obtained expresses the average length of a tracheid in contact with a ray compared with the total tracheid length, and ratios ranged in American trees from 0·072 to 0·288. Mlle. Brem finds that, if the earliest rings on lateral branches are neglected, this ratio proves a good diagnostic character to distinguish between spruce (0·1–0·2) and larch (0·2–0·3). Obviously, from the range given, this character could not safely be used alone.

Petroleum Geology of Western Canada. On February 12 Mr. A. J. Goodman read a paper before the Institution of Petroleum Technologists entitled "Notes on the Petroleum Geology of Western Canada", which includes an account of the author's conception of geological conditions obtaining in the Rocky Mountains and foothill regions respectively and of oil and gas reservoir rocks in these regions. The views expressed are founded on detailed practical work and on the collected data of numerous oil wells, as is evidenced by the number of sections, sketch maps and photomicrographs included in the report. Briefly, it is contended that in post-Cretaceous times the whole of the Rocky Mountains was compressed by the advent of geosynclinal strata between the Canadian Shield and the Jurasside Mountains; hence their wedge-shaped profile with flat overthrusts on the borders and steeper thrust faults within. Surface structures in the foothills are predominantly imbrications in Mesozoic rocks caused by the shortening of underlying Palæozoic limestone by overthrusts. Oil and gas source rocks are claimed to be primarily Palæozoic, though some may be Mesozoic. The presence of oil and gas in Mesozoic strata may be ascribed to upward migration, preservation in pores and cavities and final sealing off by secondary calcite and silica; it may be attributed in part to compression of Palæozoic limestone by the Mesozoic load and later, in Laramide times, by tectonic compression; these factors caused collapse of cavernous zones of Palæozoic limestone and consequent upward expulsion of oil and gas into the Mesozoic strata. Throughout this process the lighter constituents were retained in such small voids as escaped collapse in the reservoir rock. This separation of lighter constituents may also have been furthered by selective adsorption of secondary silica and silicates.

The Movement of Desert Sand. In a study of the movements of sand particles in a sand storm or sand cloud, Major R. A. Bagnold has criticised the view that the particles are kept aloft by upward components of the turbulence of the wind. Discussing the physics of a desert storm in a paper in the *Geographical Journal* for April, he shows that the supporting air currents, due to eddies in the wind, are not strong enough to support the average sand grain. Moreover, in open desert country where sandstorms frequently occur, the wind currents are unusually steady. Major Bagnold finds the chief cause of the flying sand grain is a bouncing action. A particle of sand gains a horizontal velocity equal to that of the wind as it is lifted off the ground. It strikes the nearest hard surface and is deflected upwards to a height determined by velocity and size. Smaller grains at rest on the ground will also be disturbed and made to splash upward into the moving air currents. The bombardment of large grains or pebbles, too heavy to be lifted by air currents, will help to move these larger grains along the surface before the wind. Furthermore, when the sand cloud reaches an area where the grains are equal in size to those in the cloud, there will be little bouncing and the grains will tend to lie on the surface. Thus, in short, sand will collect and tend to form a dune in those areas where the size of the surface grains is the same as that of the moving sand.

Lightning Photographs. The Smithsonian Institution, Washington, has accounts of two remarkable photographs of lightning taken in 1908, and now published at the suggestion of Dr. B. F. J. Schonland, of the University of Cape Town. The first was taken with a camera revolving once in five seconds. It was a very bright flash and the thunder it caused was very sharp and sudden, like the sound of a cannon. If it is assumed that the distance of the flash is 1,000 ft. which, according to Mr. Larsen, of Chicago, who observed and photographed it, is a conservative estimate, then the diameter of the flash is more than 18 ft. He describes it as a flash, between two clouds, having the appearance of a flexible tube of very large diameter, appearing instantaneously during a very heavy rainfall. The second flash photographed looks as if there were four separate rushes following one another in the path opened by the first discharge. It shows a meandering and very complicated flash. Mr. Larsen suggests that the path was a partial vacuum of low resistance, which the beaded (or striated) appearance of the flash tends to confirm. The whole flash seems to be made up of striated alternate light and dark spaces not unlike the striæ produced in a vacuum tube.

Theory of Adsorbed Films on Metals. It is well known that a sparse adsorbed layer of alkali metal atoms on a metal surface will greatly reduce the work function of the latter, and this is attributed to an electrical double layer formed by atoms which have each lost a valence electron to the underlying metal. A similar reduction of the work function is, however, obtained with a thin layer of barium, strontium or calcium on a tungsten surface; the first ionisation potentials of these elements are all higher than the work function of tungsten, and the ordinary view of the ionisation of the adsorbed atom does not apply. R. W. Gurney (*Phys. Rev.*, March 15) has examined this problem by quantum mechanics. A simplified picture shows the adsorbed atom core as a potential well separated from the potential box of the interior of the metal by a barrier. A solution of the Schrödinger equation for this system gives a set of allowed energy levels which belong jointly to the metal and the core. In practice, the $|\psi|^2$ function, corresponding to the electron density, shows a blurred energy level corresponding approximately to the ionisation potential of the adsorbed atom and filled with electrons to an extent depending on the relative positions of this level and the critical Fermi level for the metal. This model shows how an alkaline-earth atom may behave very like an alkali metal in forming a double layer. It also explains the observed variations of the strength of the double layer with the number of atoms adsorbed, and the probability of ionisation of the atoms when these are evaporated from the surface.

The Quinhydrone Electrode. The so-called quinhydrone electrode has come into extensive use since its investigation by Biilmann in 1921 and is known to be affected by salt errors, due to the change in the activity ratio of quinone and hydroquinone, the dissociation products of quinhydrone, in presence of salts. F. Hovorka and W. C. Dearing (*J. Amer. Chem. Soc.*, **57**, 446; 1935) have now carried out a systematic investigation on this matter, and their paper includes some useful practical details of the electrode. They made the comparison against a hydrogen electrode and determined the salt error for fourteen solutes at concentrations up to 2*N*. A nearly linear relation between salt error and concentration of solute was found and constants to be used in the correction of *p*H values were derived. The salt errors were found to be additive for many mixtures, which simplifies matters, but some anomalies were found with mixtures of sulphates and hydrochloric acid. The normal electrode potential of the system quinone hydroquinone was found to be 0·69938 at 25°, and the standard quinhydrone electrode was found to have a potential, with respect to the hydrogen electrode, of 0·69915 at 25°.

Constitution of Coal. Although it has long been known that coal results from the slow transformation of vegetation, the exact course of this change is still a matter for investigation and dispute. Much discussion has ranged round the question whether coal substance is the survivor of either or both the cellulosic or lignin constituents of the original vegetable matter. One method used for studying this question has been to subject coal—after extraction of resinous or oily matter by solvents—to a process of controlled mild oxidation, for example, with alkaline potassium permanganate. From the nature of the products, inferences could be made as to the constitution of the 'coal' substance from which they were derived. Since 1920 it has been known, following the work of Fischer and Schrader, confirmed by Francis and Wheeler, that benzene carboxylic acids were present in the oxidation products, pointing to the existence of ready formed benzene rings in the original coal. Prof. W. A. Bone and his collaborators have carried out such oxidations quantitatively so as to account for all the carbon in the raw material, and in a recent paper (*Proc. Roy. Soc.*, A, **148**, 492; 1935) they give the results for a complete range of materials, cellulose, lignin, peat, lignite, bituminous coal and anthracite. The products got from cellulose were almost entirely carbon dioxide and oxalic acid, with no benzenoid acids. In all the others benzene carboxylic acids were important constituents, representing up to 50 per cent of the original carbon in the case of anthracite. Small proportions of acetic and oxalic acids were also measured. From these results it is concluded that lignins have been the chief progenitors of coal substance, the cellulose having mainly disappeared during its formation. All the benzene carboxylic acids—except benzoic acid—have been isolated in the products, but the penta- and hexa-carboxylic acids predominate. The results also support the view that lignin has an aromatic structure, and favours some such constitution as indicated by the formulæ of Fuchs or Schrauth.

South African Archæology and Ethnology

THE recent issue of the *South African Journal of Science*, vol 31, contains several papers on archæology and ethnology read before the South African Association for the Advancement of Science at its meeting held at Port Elizabeth in July 1934 which are of more than local interest in their general bearing Unfortunately, it is not possible here to do them full justice, and little more than a brief reference must suffice to direct attention to the more outstanding

In his presidential address to Section E, Prof L F Mainhard, of the University of the Witwatersrand, dealt with the linguistic approach to South African prehistory and ethnology, and after discussing the general principles upon which study of the morphology and vocabulary of a language may assist the ethnologist and prehistorian, applied these principles to the problem of the distribution and relations of Bushman, Hottentot and Bantu in the prehistory and early history of South Africa A comparison of the Bushman and Hottentot tongues, as well as of the two click languages spoken in Central Tanganyika, points to a remote separation, long migration from north to south, followed by re encounter of the two peoples, and at the same time supports the view of the school in physical anthropology, which maintains that the anatomical difference between Bushman and Hottentot is a fiction. On the other hand, the Hottentot distribution at the time of Bantu invasion and the continued oncoming of the Bantu from the sixteenth century, when the Portuguese recorded that they were already occupying the south-east coast, is to be inferred from place-names, while the cultural relations of the two sets of people are indicated in their loan-words Loan words relating to cattle and magic, for example, support this argument

Among the archæological communications, that of Mr John Hewitt describes a number of arrow heads and barbs now in the Albany Museum, Grahamstown Of these, some were recently discovered by Mrs J B. Meaker in the neighbourhood of Thaba 'Nchu, with other microliths, generally at the edges of dongas where pot-clay remains These are pedunculate in form and of chalcedony or quartz Two tanged arrow-heads discovered by Mr H J Aitchison, also at Thaba 'Nchu, are of interest in view of the author's opinion that they lend support either to the view held by the Abbé Breuil that the tanged arrow-head is a contribution to South African culture of the northern neolithic of the proto-dynastic civilisation, or that it is a locally evolved derivation from uninfluenced Still Bay or Wilton

Canon W. G. Sharples argues against the human origin of the so-called "Victoria West Implements" in dolerite, and demonstrates the production of implement-like forms in this material by purely natural causes.

An important paper by Dr P. W Laidler deals with the archæological and geological sequence in the Transkei and Ciskei. He points out that while it is probable that the stone age cultures of South Africa were less ancient than their European parallels, the absence of Pleistocene ice ages in South Africa deprives archæologists of the assistance they afford in Europe. There is, however, evidence in the Ciskei and Transkei of archæological relationship with pluvial periods which correspond with the phases of the ice age. As a result of the demonstration of the relation of deposits and types of industries on a number of sites, it is concluded that Stellenbosch occurred in a wet period, in which terrace gravels were laid down, possibly Gunz-Mindel, Riss-Wurm, while Fauresmith, now shown to be widely distributed and not restricted to the Free State, belongs to the gravels of a decreasing rainfall, a Levallois technique being present This culture is shown to evolve from a late Stellenbosch and to pass into the Middle Stone Age, a graded series having been found on a site at Bonza Bay The excavation of a Transkeian cave produced further evidence of the course of evolution of the Middle Stone Age, showing that high-backed, parallel flaked, lance-heads with revolved flaking preceded leaf-shaped secondarily worked blades During the Middle Stone Age there was a further wet period, producing a layer of stalagmite in a cave where all rock is now dry, and possibly equating with Buhl The leaf points coincide with a dry period, while the Middle Stone Age closed with a period of seasonal rains In the late Stone Age modern dry climate supervened

In physical anthropology the skeletal structure of the Bushman naturally figures prominently A symposium of members of the Department of Anatomy, University of the Witwatersrand, took place in which the physical characters of the Bushman were subjected to examination in detail This is here reported in very full abstract, and inevitably will in future be regarded as a standard reference.

Before dealing with this communication, however, mention must be made of a report on human skeletal remains from East London, presented by Mr L H Wells, of the Department of Anatomy, University of the Witwatersrand The material was obtained by Dr P W Laidler during his excavations on East London sites, and provides the physical anthropological counterpart of the archæological results The remains fall into three groups The 'Main Series' from various sites consists of eleven individuals, mostly of recent prehistoric age, the second group, the Quigney Sluit series, belongs to the period of European occupation and the third, the Cemetery series, comprises three skulls from a Bantu cemetery dated *circa* 1800–1870 As a general result, it is said that the heterogeneous character of the material points to the fundamental importance of adequate definition of ethnic types in South Africa The presence of Bantu features in the more recent skeletons is the physical counterpart of Maingard's historical data of the infiltration of the Bush population of this area by a Bantu element , and the predominantly Bush-Boskopoid character of the Cemetery series is striking evidence of the persistence of this ancient type, despite subsequent changes in the population

The symposium on the "Skeleton of the Bush Race" consists of eight communications, each dealing with some specific investigation based on known Bush material, partly from the McGregor Memorial Museum, partly from the anthropological collection of the Department of Anatomy at the University of the Witwatersrand The points covered include the skull, mandible, dentition, shoulder girdle and upper limb, vertebral column, sacrum and lower limb So far as the detailed results here recorded may be reduced to any general principle, it is that they point to the Bush type being highly evolved, but at the same time much specialised Thus in relation to the calvaria, it is pointed out that an examination of curvatures of the crania show that the Bushman occupies a higher evolutionary place than Cro-Magnon man, and according to one method of study even a higher rung than the European This latter result, however, is due to the employment of a method which as a measure of fœtalisation points to an extreme specialisation rather than a high status in evolutionary development In the examination of the pelvis, by Miss Margaret Orford, the results point to the similar indication of specialisation She concludes that the Bush pelvis is primitive or ape-like in many respects; and on the whole the Bush female pelvis exhibits primitive characteristics in more exaggerated form than does the male The bones are small in absolute measurement, but massive in proportion to their size The sex differences are well-marked The Bush pelvis was capable of developing secondary specialisations, such as the exaggerated features of sexual differentiation, the shallow acetabulum, etc It is, therefore, an intimate admixture of primitive and specialised features

Systems of Economic Reform

DURING recent years, men in all walks of life have begun to question the present structure of society with its apparently inevitable liability to periodic maladjustments, and in an endeavour to suggest a remedy of present ills, all kinds of proposals have been put forward The very multiplicity of these plans for economic betterment, however, is bewildering and confusing, even to those who have the time to examine them in some detail For this reason alone the recent publication by the Engineers' Study Group on Economics of a chart analysing in convenient form the salient features of fourteen different proposals for economic reform should serve a useful purpose In addition to this chart, the Group, which was formed by a number of engineers and men of science somewhat more than a year ago, has recently prepared a valuable interim report* which examines twenty four separate sets of proposals, analysing them under three headings, namely, (*a*) monetary, (*b*) industrial planning and (*c*) a combination of industrial planning and monetary The real division of opinion which this classification is intended to emphasise is that existing between those who think that prosperity can be reached by alterations, radical or otherwise, in the monetary system, and those who believe that some control of industrial production is required The division is also of importance in respect of immediate practical possibilities Few if any of the monetary proposals would require elaborate preliminaries, and most of them could be brought into full operation in a comparatively short time It is otherwise with the schemes which involve planning, as these would almost invariably take time to put into practice

Most of those who make proposals for economic reforms start with an analysis of the present situation, and there is a considerable difference of opinion as to the main causes of the position, though there is a measure of agreement among certain groups of schemes Several of the proposals for monetary reform definitely assert, that insufficient purchasing power is at present distributed to purchase the goods which are being produced. The supporters of the Consumer Money League and of the Social Credit Scheme of Major Douglas assert that this deficiency is automatic and inevitable, accordingly the Consumer Money League advocates local note issues, while the Douglas proposals suggest remedying the deficiency either by issuing credit to retailers conditionally on sales at regulated prices, or by way of a 'national dividend' to every individual

In the opinion of Mr J M Keynes, the deficiency of purchasing power is not necessarily permanent, and his immediate remedy for the present situation is large scale public works, financed by Government loans The London Chamber of Commerce suggests the monetisation of commodities by issuing currency against eligible trade bills Silvio Gesell's 'Demurrage Money' scheme, which involves the elimination of interest, and the Kearney 'True Finance' scheme also assert that there is insufficient purchasing power, but their main remedy is designed to correct this shortage by increasing the velocity of circulation rather than the amount of money

Two more schemes, those of Lord Melchett and Prof F Soddy, diagnose a shortage of effective purchasing power, but do so somewhat less definitely than is the case with the other schemes previously mentioned Lord Melchett proposes to meet the apparent shortage by monetisation of commodities and by paying off the National Debt by means of bank drafts Prof Soddy holds that the shortage is due to the fact that it is to the interest of the bankers who control the issue of money to keep it scarce, and he therefore advocates the nationalisation of the issue of currency and credit and the control of such issues by a scientifically determined price index

The three remaining monetary schemes examined in the report, namely, those of McGregor, Deane and Sir Basil Blackett, stress lack of balance as being mainly responsible for the present situation The McGregor plan defines balance as that between spending and saving, and holds that the existing situation is due to over saving and that it can be rectified by raising or lowering the general salary and wage level by carefully calculated percentages The Deane plan, which is American in origin, stresses mal distribution of purchasing power resulting from technological unemployment as the root of the trouble and accordingly proposes a special kind of unemployment insurance Sir Basil Blackett suggests, in his "Planned Money", that the lack of balance is more general and requires to be remedied by a currency based on a price index and managed with the view of maintaining stable prices He also commends planning and co-ordination

The next group of schemes arraigns unco-ordinated individualism as largely responsible for the present troubles The schemes can conveniently be analysed into two sections, namely ·

(*a*) Mr Harold Macmillan's "Reconstruction" proposal, Fascism, the 'New Deal' in the United States, and the schemes of the 'New Britain' Group and of the 'Political and Economic Planning' Group.

(*b*) H S Jevons's 'Credit Income System', Communism, Technocracy, the programmes of the Labour

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* The British Science Guild Engineers' Study Group on Economics First Interim Report on Schemes and Proposals for Economic and Social Reforms Pp 44 (London British Science Guild, 6 John Street, Adelphi, W C 2, Engineers' Study Group on Economics, Hazlitt House, Chancery Lane, W C 1 1935) 1*s*

Party and of the Socialist League and the scheme propounded by Edward Bellamy in "Looking Backwards" (published 1865)

Each of the schemes in section (*a*) proposes a planned and co-ordinated economic system, but none of them, except that of the 'New Britain' group, involves a departure from the basis of private enterprise Planning and co ordination are also part of the Conservative and Liberal proposals, but for them the main source of our troubles is to be found in the international sphere Both recognise, however, that the international situation is not capable of direct control, and therefore planning in some degree becomes a necessary national policy Mr Harold Macmillan proposes a compromise between the individualist and collectivist lines of thought A Central Economic Council would aim at maintaining equilibrium between supply and demand by expanding demand, remembering that the worker is also a consumer Labour would be represented on this Council, and while interference by workers in the daily management of industry is rejected, the industrial system would be humanised and opportunities for speculative profits much reduced

The six schemes in section (*b*), while they stress the failure of unco ordinated individualism, are sharply distinguished from those in section (*a*) by their emphatic assertion that the underlying causes of our present economic troubles are the 'profit motive' and private ownership of the means of production They regard a shortage and mal distribution of purchasing power as inevitable so long as these continue, and they therefore propose that the community should take over the ownership, if not the operation, of all production

University and Educational Intelligence

CAMBRIDGE —The Adams Prize for 1933-34 has been awarded to Dr Sydney Goldstein, former fellow of St John's College Dr L Rosenhead, St John's College, is highly commended for his essay The prize is awarded every two years for an essay on some branch of pure mathematics, astronomy, or other branch of natural philosophy The Sheepshanks Exhibition for astronomy, valued at about £40 for three years, has been awarded to S W Shivershwarkar, scholar of Sidney Sussex College The successful candidate is required by statute governing the award to become a member of Trinity College

An appointment to a Busk studentship in aeronautics will be made in July The studentship, worth £150, is tenable for one year, during which period the holder will be expected to devote his whole time to research Forms of application may be obtained before June 8 from Prof B Melvill Jones, Engineering Laboratory, Cambridge.

LONDON —The following appointments have recently been made Dr C H Lobban, since 1926 University reader in civil engineering at King's College, to be professor of civil engineering, King's College, from October 1, 1935 ; Dr A St G J McC Huggett, since 1931 reader in pharmacology and member of the physiology staff in the University of Leeds, to be professor of physiology, St Mary's Hospital Medical School, from October 1 ; Mr J P Ross, since 1931 University reader in surgery at St Bartholomew's Hospital Medical College, to be professor of surgery, St Bartholomew's Hospital Medical College, from October 1 , Dr H A Moss, since 1928 director of the Tyneside Council of Social Service, to be reader in sociology, Bedford College, from October 1

The title of professor of political economy in the University has been conferred on Mr N F Hall, in respect of the post held by him at University College

OXFORD The scientific contributions of early members of the Queen's College formed the subject of Dr R T Gunther's lecture last week, with especial reference to the work of Edmond Halley and Thomas Pennant who to a very large extent have the credit for having secured the publication of Newton's "Principia" and Gilbert White's Natural History of Selborne" Sir John Floyer, the inventor of the pulse watch and advocate of cold bathing, was also a member of the College

COMMONWEALTH Fund Fellowships tenable by British graduates in American Universities for two years beginning September 1935, have recently been awarded to the following, among others Dr F X Aylward (Liverpool) to Johns Hopkins University, in biochemistry , Miss M E Francis (Girton College, Cambridge) to the University of California, in geography , A R Gemmell (Glasgow) to Rutgers University, in plant pathology , Dr Ronald Grant (Queen Mary College, London, and Universities of Edinburgh and Leeds) to the University of Chicago, in zoology , J G. M Hamilton (Edinburgh) to Harvard University, in medicine , W R Hawthorne (Trinity College, Cambridge) to the Massachusetts Institute of Technology, in engineering , Miss G G Leybourne (University College, Cardiff) to the University of Chicago, in statistics , F V Price (New College, Oxford) to Princeton University, in physics , M H L Pryce (Trinity College, Cambridge) to the Institute for Advanced Study, in mathematics , G D Rochester (Armstrong College, Newcastle) to the University of California, in physics , E D Tagg (Claire College, Cambridge) to Princeton University, in mathematics , Harold Walke (University College, Exeter) to the University of California, in physics , Kenneth White (Queen's College, Oxford) to the University of Chicago, in economics , John Wilkinson (Armstrong College, Newcastle) to Harvard University, in botany , R B Williams (Corpus Christi College, and New College, Oxford) to Princeton University, in chemistry , Leslie Young (Imperial College of Science and Technology and University College, London) to Washington University, in biochemistry R B Bryce (Toronto and St John's College, Cambridge) has been awarded a British Dominions fellowship to Harvard University, in economics The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas W E Cohen (Western Australia, and Council for Scientific and Industrial Research, Australia) to the University of Wisconsin, in wood chemistry , H C Forster (Melbourne, and the Department of Agriculture, Victoria) to Iowa State College, in agriculture , J G Gibbs (New Zealand, and the Department of Agriculture, New Zealand) to the University of Minnesota, in agriculture , H. J. N Hodgson (Melbourne, and the Engineering and Water Supply Department, South Australia) to Harvard University, in engineering , C C Wessels (Pretoria, and the Department of Agriculture, South Africa), in veterinary science

Science News a Century Ago

Ascension Island

Ascension Island, which has the smallest population of any British Dominion, was taken over in October 1815. Twenty years later, at a meeting of the Royal Geographical Society on May 25, Joseph Sabine read an account of the island written by Mrs. Colonel Power. Ascension was of interest, Mrs. Power said, for the examples which it furnished of changes wrought, even in climate, by very recent cultivation. A few years previously, it was a bare and barren cinder rising out of the waters, yielding nothing to voyagers except turtle and a very little fresh water painfully collected when required, from one or two dropping springs. When Bonaparte, however, was confined at St. Helena, it was occupied by way of precaution by a party of marines, and had so rapidly improved under their charge, and been found so healthy, and otherwise so convenient for the refreshment of ships either passing to India or attached to the African station, that it was permanently occupied; and a most interesting study it appeared to afford to the physical geographer. It was Capt. Bate, of the Royal Marines, who provided a proper water supply. He sunk a well in a ravine on the north side of the island. The spring yielded 50 tons a day and the water was conveyed to the anchorage, the pipes in one place being taken through a tunnel 1,000 ft. in length. The charge for water for strangers was 5*s.* a ton if delivered in Government boats or 3*s.* if carried off in the vessels' own boats. There was never less than 1,500 tons in the great tank on the beach. Mrs. Power gave particulars of the plants which had been introduced, and said that rain had become more frequent while there was little doubt that, in time, the whole island would be cultivated, and Ascension, from a barren rock, would be made to resemble the Azores, Madeira and other Atlantic islands.

Murchison on the Geology of Shropshire

Murchison, in some of his memoirs to the Geological Society, pointed out the existence of certain bedded trap rocks, interstratified with transition deposits, and of other intrusive trap rocks which have been afterwards injected amid these stratified masses, and on May 27, 1835, he read a paper to the Society entitled "On Certain Lines of Elevation and Dislocation of the New Red Sandstone of North Salop and Staffordshire, with an Account of Trap Dykes in that Formation at Acton Reynolds near Shrewsbury". The Breiddin Hills, he said, afford examples of both classes of trap rock, and the conclusions to which he had come were: (1) Certain trap rocks were evolved during the formation of the transition rocks; (2) others burst forth after the consolidation of these older strata, throwing them into vertical and broken forms and producing metalliferous veins in them; (3) this period of activity was anterior to the formation of the Coal Measures, as is proved by the strata of the latter resting unconformably upon the highly inclined edges of the transition rocks; (4) igneous agency evolving precisely similar products was renewed at a much later period upon one of these lines of ancient eruption; and (5) the great disruptions around the flanks of the central coalfields of England took place after the accumulation of the New Red Sandstone.

Fulton's Grand Orrery

In its column of "Weekly Gossip on Literature and Art", the *Athenæum* of May 30, 1835, said: "Another Exhibition, worthy of notice, is Fulton's grand Orrery, now to be seen in Bond Street, one of the most ingenious specimens of mechanical contrivances that has yet been exhibited. The planets and their moons revolve in their true relative periods, the inclination and eccentricity of the planetary orbits are shown with great accuracy, and from half an hour's inspection of this beautiful machine, a person unacquainted with mathematics may form a very good notion of the principal phenomena of the solar system. The proprietor has made every part of the mechanism with his own hand, and he cheerfully explains all the movements, thus rendering the Exhibition as useful to the mechanist as it is delightful to the astronomical student."

Societies and Academies

Paris

Academy of Sciences, April 8 (*C.R.*, **200**, 1257–1372).—Paul Langevin and Jacques Solomon: The laws of the disengagement of electricity by torsion in piezo electric substances. The general theory of piezo electricity developed twenty-five years ago by W. Voigt is capable of predicting the phenomenon of stropho-electricity, recently described by Tawil and by Ny Tsi-Ze and Tsien Ling-Chao. The formulæ obtained from Voigt's theory, although differing from those suggested by Tawil and by Ny Tsi-Ze and Tsien Ling Chao, are in good agreement with their experimental results. Richard Fosse, Paul Emile Thomas and Paul De Graeve: The action of hydrazine on the cyclic ureides (parabanic acid). Georges Darmois: The laws of probability with exhaustive estimation. P. Vincensini: Ribacour's transformation of Guichard surfaces. A new aspect of Eisenhart's transformation. Serge Rossinski: The deformation of surfaces with persistent conjugated network. Alfred Rosenblatt and Stanislaw Turski: The coefficients of series of univalent powers in the unit circle. Solim Mandelbrojt: A problem of Carleman. André Magnier: The limiting values of harmonic functions. Harald Bohr: A general theorem of integration of a trigonometric polynomial. L. Pontrjagin: The Betti numbers of Lie groups. Elie Cartan: Remarks on the preceding communication. Silvio Minetti: The trend of a uniform function in the neighbourhood of an isolated essential singular point. Alexandre Dufour: A suggestion for an experiment concerning classical kinematics and relativist kinematics. Victor Volkoviski: Chains of vortices. Caïus Jacob: Some properties of the general solution of a problem of H. Villat and R. Thiry. Henri Abraham: Free electrons in astrophysics. René Coudero and Jean Danton: The discovery of a remarkable submarine plateau between Madeira and Portugal. L. Goldstein: The non-adiabatic character of the variations of nuclear charges. Mlle. Marie Antoinette Baudot: The properties of the $\Psi(2\omega)$ space and their applications. Jean J. Trillat and Hans Motz: The formation and structure of monomolecular or bimolecular layers of fatty substances on metallic surfaces. Spectrography with X-rays fails with very thin layers, but utilising electronic analysis of films on a surface of gold, evidence of the structure can be obtained. The electronic analysis of metallic films, originally giving the diagram of the pure metal, shows the presence of fatty layers as impurities after keeping for several months. Theodore Ionescu and Constantin Mihul. The propagation of electric waves in the earth's magnetic field A development of the theory of the propagation of electric waves in the ionosphere, taking into account the action of the earth's magnetic field It is claimed that this modified theory fully explains the experimental results without recourse to the hypothesis that the ionosphere is composed of several ionised layers. Romolo Deaglio The interior unipolar conductivity of certain crystals A Cotton · Remarks on the preceding communication The *Indian Journal of Physics* (March, 1935) contains an article by S. R. Khastgir and Das Gupta describing experiments leading to similar conclusions as those obtained by R Deaglio Edgar Pierre Tawil Considerations on the disengagement of electricity by the torsion of quartz and on the reciprocal phenomenon The author maintains that strepho-electricity and piezo-electricity are distinct phenomena Gaston Dupouy · The experimental properties of paramagnetic substances. Fundamental characters interpretation. Georges Liandrat Concerning the Schottky effect in photo-elements with boundary layer. Georges Zielinski. The polarisation of the 2540 A and 2650 A fluorescence bands of saturated mercury vapour Mlle. Yvette Cauchois Study of the L spectrum of mercury André Michel and Jacques Bénard: The formula of ferromagnetic chromium oxide The formula CrO_2 is attributed to the ferromagnetic oxide. it cannot be obtained pure Mlle Suzanne Veil · Electrical phenomena connected with diffusing salts meeting in gels Mlle Niuta Klein: The variation of the coefficient of expansion of glass with annealing Marcel Prettre The function of the surface in certain homogeneous reactions depending on a chain mechanism. Discussion of the causes of the differences observed in homogeneous gas reactions at high temperatures between uncovered walls (glass, silica) and walls covered with a layer of potassium chloride G Chaudron and R Dandres. Contribution to the study of the alloys formed by the aluminium-magnesium solid solution. Pierre Süe. The physicochemical study of the neutralisation of aqueous solutions of the sodium niobates Léon Palfray and Alfred Leman. The chemical activity of the naphtholic hydrogens of 1, 7 dihydroxynaphthalene. The reactivity of the two hydroxyl groups is of the same order. Henri Longchambon The properties of the Ampandrandava sepiolite Auguste Chevalier, Léonce Joleaud and Georges Petit: The quaternary deposits of the old crater of Pedra de Lume (Sal Island, Cape Verde Archipelago). Georges Schneider: The leakages of hot mineral spring water from the Soufre spring at Aix-les-Bains. Robert Perret: The Adrar des Asger (Sahara). Adolphe Lepape and Georges Colange: Apparatus for taking samples and the study of the composition of the air of the stratosphere. Louis Eblé: The annual variation of the terrestrial magnetic field. Paul Bertrand, Rodolphe Böhm and Paul Corsin: Discovery of a flora in the Lydian of the Montagne Noire Carboniferous at Saint-Nazaire-de-Ladarez (Hérault). M. Masoré and Mlle. A. Rollen: The influence of the tensio-negativity on the structure of the plant cell Mlle. Panca Eftimiu · The cell formations contained in the cytoplasm of *Bucegia Romanica*. V. Grégoire: The morphogenetic connexions between the leaf and the stem in the Dicotyledons. Louis Hédin: Observations on the knots of the vine. Basile Luyet and Ruth Ernst The non-existence of the nuclear membrane Henri Hermann, Georges Morin and Joanny Vial · The persistence of anaphylactic shock in the dog after removal of the spinal cord. Pierre Noguès The measurement of arterial pressure J André Thomas. The persistence of the secreting function of the entoblasto-vitellogen cell in the course of its transformations *in vitro*. The vitellogen macrophage Paul Wintrebert: A new theory of development. physiological epigenesis, or theory of chains of functions Emile Pillet The orientation and pyro-electricity of crystals of ammonium magnesium phosphate in calculus concretions of the kidney and bladder Charles Dhéré and Mlle Anne Raffy · The fluorescence spectra of phoophorbides Paul Cristol, J Fourcade and R Seigneurin The existence of a dissociation of urea in dilute solution The view that urea undergoes dissociation on dilution is supported by measurements of the lowering of the freezing point, the irregularity of the conductivity curves and diminution of the pH Georges Sandor · The isoionic point of the proteins

Leningrad

Academy of Sciences (*C R*, 1, No 5, 1935) G. Duboshin The stability of solutions of canonical systems A. Bermant and M. Lavrentijev. The absolute constants analogous to the constant of A Bloch V Kalashnikov and A Kurosh · Free products of groups with the united subgroups of centres A. Marchenko. A conformal representation of a circle. V. Fesenkov. Determination of the deficiency of the radiation in sunspots. A description is given of a special apparatus devised for the purpose. A Tichonov. Theorems of the unicity for the equation of heat transmission. S. Shubin. An elementary proof of the statistical formulæ on which chemical thermodynamics are based S Gutmann, P. Rehbinder, M Schulvas, M Lipetz and M. Rimskaja: Colloidal physico-chemical methods for the separation of slag inclusions in steel, from carbides N Zelinskij: On cyclohexadienes A. Filippov and J Tolmachev: The presence of rare alkaline metals in amazonites D. Kostov and I. Aksamitnaja Studies on polyploid plants (7). Chemical analysis of F_1 hybrids and their amphidiploids D Kostov. Studies on polyploid plants. (8) Chromosome conjugation in the haploids and its genetical significance B Morozov: Influence of hyposulphite on regeneration in Amphibia. Hyposulphite exerts little influence; the early stages in development are more sensitive than later stages. G Molotkovskij. A chamber for the hygroscopic paper strips used in the determination of the rate of transpiration by the cobalt method. E. Hasratian: The influence of a conditioned motor defensive reflex on an unconditioned reaction of a dog to pain. S Chernov: Two representatives of the genus *Oligodon* (Ophidia, Colubridae) in the Soviet Union.

C.R., 1, No. 6; 1935. A. Alexandrov A new proof of the non-flexibility of the sphere B Vulich: Some theorems on series of discontinuous functions. B. Wul and I. Goldmann The influence of photo-electric stream on the penetration tension. G. Krutkov · Brownian rotation of a particle with a symmetry axis. K. NIKOLSKIJ: Contribution to the theory of the photon. M USANOVICH: Diagrams of the physico-chemical analysis of binary liquid systems P. PORFIROV The problem of hydrogen over-voltage G CHELINTSEV: The mechanism of condensation of carbonyl compounds under the influence of alkaline metals. J KANAJEV Influence of vital stains on *Trichodina* A. LINDBERG Action of ethyl alcohol on the outer layer of the cerebral hemispheres V KAZANCEV: Contribution to the problem of regeneration of striped muscle tissue in mammals N NASSONOV The rôle of cartilage in development in axolotls A SVETOVIDOV (1) Black Sea subspecies of the whiting (*Gadus merlangus euxinus*) (2) A second species of cod of the genus *Boreogadus* (*Boreogadus agilis*, Reinhardt)

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, May 26

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 — J. R Norman "Fishes" *

Monday, May 27

VICTORIA INSTITUTE, at 4 30 —Prof Arthur R Short "Some Recent Literature concerning the Origin of Man"

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY, at 5 30 —(at the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1) —Dr May Smith "Industrial Applications of the Temperamental Factor" *

ROYAL GEOGRAPHICAL SOCIETY, at 8 30.—Major C J Morris · "A Journey in Bhutan"

Wednesday, May 29

KING'S COLLEGE, LONDON, at 5 30 —Don Juan de la Cierva "The Autogiro" *

BIRKBECK COLLEGE, London, at 6 —C E M Joad 'Science and Human Freedom" (Haldane Memorial Lecture) *

Thursday, May 30

ROYAL SOCIETY, at 11–1 and 2 30–4 —Discussion on "Supraconductivity and other Low-Temperature Phenomena", to be opened by Prof J C McLennan

ST MARY'S HOSPITAL, LONDON, at 5 —Dr R. G Canti "The Cultivation of Living Tissue".*

ROYAL AERONAUTICAL SOCIETY, at 9 —(in the Science Museum, South Kensington, S W 7) —D. W. Douglas "Developments in the Modern Air Liner" (Wilbur Wright Memorial Lecture).

Friday, May 31

ROYAL SOCIETY OF ARTS, at 4 30 – B C Burt "The Position of the Sugar Industry in India"

ROYAL INSTITUTION, at 9 —Major C E S Phillips "The Characteristics of Violin Tone"

Official Publications Received

GREAT BRITAIN AND IRELAND

British Industries Fair, Engineering and Hardware, Birmingham. Organised by the Chamber of Commerce, Birmingham, being an Integral part of the Board of Trade British Industries Fair; May 20 to May 31, 1935. Pp 410+iv+501–684. (Birmingham · Chamber of Commerce.) 1*s*.

Scottish Marine Biological Association. Annual Report, 1933–34 Pp 25. (Glasgow Scottish Marine Biological Association.)

Fifty Years of Chemistry, 1885–1935 By Dr Arthur E. Everest. Pp. 20. (London: Institute of Chemistry)

Ollscoil na h-Eireann (The National University of Ireland) for the Year 1934 Pp viii+307+506+302 (Dublin . University of Ireland)

The Institution of Professional Civil Servants Annual Report of Council for the Year 1934 Pp xiv+48 (London Institution of Professional Civil Servants)

Report of an Inquiry into the Effects of Existing Economic Circumstances on the Health of the Community in the County Borough of Sunderland and certain Districts of County Durham By Dr James Pearse, Dr J Alison Glover and K W Grant. (Cmd. 4886) Pp 52 (London H M Stationery Office) 9*d* net

Transactions of the Royal Society of Edinburgh Vol. 58, Part 2, No 13 Scottish Lower Carboniferous Plants, The Fossil Hollow Trees of Arran and their Branches (*Lepidophloios Wünschianus* Carruthers) By Dr John Walton Pp 313–337+5 plates (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd) 5*s*

OTHER COUNTRIES

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 86 A Soil Survey of the Berri, Cobdogla, Kingston and Moorook Irrigation Areas, and the Lyrup Village District, South Australia By T J Marshall and P D Hooper Pp 55+5 plates Pamphlet No 53 The Identification of Wood by Chemical Means. Part 2 Alkalinity of Ask and some Simple Chemical Tests for the Identification of the Coloured Woods of the Genus Eucalyptus By W E Cohen (Division of Forest Products, Technical Paper No 15) Pp 23 (Melbourne Government Printer)

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève Vol 41, Fasc 3 Études sur la partie occidentale du Lac de Genève, 2 Histoire malacologique du Lac de Genève Par Jules Favre Pp 295–414 (Genève Georg et Cie) 10 francs

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Smithsonian Miscellaneous Collections Vol 91, No 19 Reports on the Collections obtained by the First Johnson—Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Parasitic Copepods By Charles Branch Wilson (Publication 3298) Pp 9+3 plates Vol 91, No. 20 Reports on the Collections obtained by the First Johnson—Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—*Bollmania litura*, a New Species of Goby By Isaac Ginsburg (Publication 3299) Pp 3+1 plate Vol 93, No 7 The Christiansen Light Filter, its Advantages and Limitations By E D McAlister (Publication 3297) Pp 12+2 plates No 93, No 8 The Classification of the Edrioasteroidea By R S Bassler (Publication 3301) Pp 11+1 plate Vol 94, No 1 The Darker Side of Dawn By Ananda K Coomaraswamy (Publication 3304) Pp 18 (Washington, D C Smithsonian Institution)

U S Department of the Interior Geological Survey Bulletin 860 A Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico Part 1 The Coal Field from Gallup eastward toward Mount Taylor, with a Measured Section of the Pre-Dakota (?) Rocks near Navajo Church By Julian D Sears Pp iv+29+17 plates 35 cents Water-Supply Paper 660 Artesian Water in Somervell County, Texas By Albert G Fiedler Pp iv+86+7 plates 15 cents (Washington, D C Government Printing Office)

U S Department of the Interior Office of Education Bulletin, 1933, No 2 Statistics of Higher Education, 1931–32, being Chapter III of the Biennial Survey of Education in the United States, 1930–1932 Pp vi+401 25 cents Bulletin, 1934, No 2 Institutions of Higher Education in Norway. By Alina M Lindegren Pp vii+96. 10 cents Bulletin, 1934, No 5 Public Education in Puerto Rico By Katherine M Cook Pp viii+53 15 cents Bulletin, 1934, No 10 Foreign and Comparative Education, a List of References. By Severin K Turosienki Pp vii+59 10 cents. Bulletin, 1934, No. 13 Institutions of Higher Education in Denmark By Alina M. Lindegren Pp ix+126 10 cents Bulletin, 1934, No 17 Accredited Secondary Schools in the United States By Margaret J S Carr Pp v+127 15 cents. Pamphlet No 55. Teachers' Problems with Exceptional Children .5 Crippled Children By Beatrice McLeod Pp iii+18 5 cents. (Washington, D C Government Printing Office)

Cornell University. Agricultural Experiment Station Bulletin 617 Interests, Activities and Problems of Rural Young Folk 1 Women 15 to 29 Years of Age By Mildred B Thurow Pp 57 Bulletin 618 Electric Hotbeds for Propagating Woody Cuttings By Donald Wyman and Maurice W. Nixon Pp. 21 Memoir 165 Forest-Type Studies in the Adirondack Region. By Carl C Heimburger Pp 122. (Ithaca, N Y, Cornell University)

Jamaica Annual Report of the Department of Agriculture for the Year ended 31st December 1933 Pp ii+46+iii (Jamaica Government Printing Office, Kingston)

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Ontario Research Foundation Report for the Year 1934 Pp 31 (Toronto King's Printer)

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A Short List of Second-hand Books chiefly in Science and Mathematics (Catalogue No 367) Pp 30. (Oxford. B. H. Blackwell, Ltd)

A Catalogue of Important and Rare Books on Recent and Fossil Invertebrata (chiefly Echinodermata), Palæontology and Geology, including the Library of the late Dr. Francis A Bather (No 504) Pp 52. (London Bernard Quaritch, Ltd)

Boots Products in the treatment of the Anaemias Pp. 31. (Nottingham: Boots Pure Drug Co, Ltd.)

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Industrial Recruitment and Unemployment Problems

NO passage in the King's speech on the evening of May 6 won more cordial approval than his reference to the unemployed. In the midst of the rejoicings and demonstrations of loyalty, at a time when the industrial population of Great Britain was never so large, his words reminded all that there are still more than two million unemployed The King's wish and appeal to find them work takes us to the central problem. The development of minor interests, the provision of occupations for occupation's sake, even the provision of allotments, may do much to bring them hope and a sense of fellowship with the community It does not touch the real need Only as they find work and recover an established place in the scheme of things can they regain their independence and true estate of manhood or womanhood

To that task, scientific workers cannot be indifferent. Both rightly and wrongly, science has been blamed for much of the human wastage which has come from the rapid application of scientific knowledge in industry and elsewhere. Scientific workers have their own contribution to make in the concentration of purpose and concerted endeavour which will remove the reproach of chronic, hopeless unemployment from our land, and happily *they are increasingly displaying their* sense of this responsibility

Despite the attention which has been focused upon this problem in recent years, there is still no definite answer to the question how we are to find work for the unemployed on the scale required. The magnitude of the problem is well defined and the interpretation of the statistics of unemployment has been ably discussed before the Royal Statistical Society by Mr J A Dale It is clear, moreover, that no revival of trade such as may be looked for with any reasonable confidence offers the prospect of absorbing more than a fraction of the numbers concerned

It is also more widely realised that the problem of unemployment needs to be considered as a whole, and a policy developed which takes into account all the relevant and definitely ascertained facts. Attacks on the problem piecemeal, even on such special aspects as that of juvenile unemployment, can never yield adequate results and may indeed place obstacles in the way of the more far-reaching measures which the consideration of the whole problem would suggest. Two reports, entitled "The Entrance to Industry" and "The Exit from Industry", which have been issued by P E P[*], commend themselves particularly to the scientific worker for this reason. They are concerned with the social and individual, rather than the purely industrial aspects of unemployment, and make a noteworthy attempt to deal with the problem as a whole. They bring discussion to a concrete point and set forth facts and figures which must be accepted or refuted.

Both reports have as their background the conception of social security—the continued development on lines the soundness of which has been demonstrated by the severe tests of recent years of those measures of social insurance which should guarantee that no one shall starve or be ignorant or suffer ill-health, merely because he is poor or destitute. They direct attention to points of friction and danger which still exist in the wage-earner's life and to their effects on the question of unemployment as a whole.

In the first place, both reports demonstrate that the task is not simply to find or create an additional two million or more paid jobs of some sort. Increasing employment cannot be of much help unless we simultaneously maintain and if possible raise the quality of employment. That means not only increased earnings but also an enhanced status for labour, shorter working hours, holidays with pay, welfare work, provision for retirement in old age.

It must also be recognised that all employment has not the same social value. The employment of a man in middle life who may be the head of a family, for example, is socially more important than the employment of a young person or of an elderly person, even when all regard is had to the much more serious effects of continued unemployment on the young.

These two reports are accordingly based on the principle that any adequate employment policy must not only raise the status and standards of labour but also concentrate employment primarily upon those for whom it is economically most necessary and socially most desirable—that is to say, upon able-bodied men in the prime of life, most of whom are or should be supporting wives and young families. The proposals advanced are thus not to be regarded simply as schemes for raising the school-leaving age, for day continuation schools, for retirement pensions and so forth, but as carefully considered and immediately practicable sections of a new social and economic structure in which the gains of individual enterprise and self-reliance will be preserved, while the insecurity which undermines peace of mind and co-operation, together with the exploitation of boys and girls by their parents and employers at the expense of their futures and of the national good, will be smoothly and permanently eliminated.

It is from this point of view that the first report directs attention to the conspicuous gap in our social services in the provision for boys and girls between fourteen and eighteen years of age. Between these ages, boys and girls pass through a vital phase in development. Important changes take place in their physical and psychological make-up, and their adult character begins to emerge. The importance of these years has been largely overlooked both by industrialists and by the community as a whole. In the absence of a carefully planned recruitment policy in particular industries, scientific vocational guidance is extremely difficult, and misfits, blind alley work and eventual unemployment often cannot be avoided. Although at the moment the number of school leavers is increasing, within the next forty years the age group fourteen to eighteen is expected to decrease considerably and to represent a much smaller proportion of the total population. Its economic and social value will correspondingly increase, and the elimination of waste and frustration as well as the raising of its quality by more careful preparation for industry, citizenship and leisure becomes correspondingly even more important.

Such considerations endorse the policy already suggested when the problem is viewed against the background of adult unemployment. The report accordingly advocates a definite policy for this age group: to extend educational influences over the whole period, to ensure that the health of boys and girls is supervised effectively up to the age of eighteen and to introduce an organised system of industrial recruitment, training and welfare supervision. As concrete proposals it recommends raising the school-leaving age to fifteen years and smoothing the transition from tutelage to self-dependence by introducing compulsory half-time attendance at day continuation schools up to the age of eighteen. It is estimated that these proposals would eliminate most unemployment among boys and girls and create opportunities for the absorption of about half a million unemployed men and women over eighteen by 1940, at a net cost of between £9 millions and £14 millions if maintenance allowances were not paid to those above fifteen years of age, and between £20 5 millions and £25 5 millions if maintenance allowances were paid at the rate of 5*s* per week

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[*] "The Entrance to Industry: a Survey of Points of Contact between Education and Industry in Great Britain, together with Proposals for raising the School Leaving Age and for Part Time Continued Education until 18, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning)". Pp. 56. 1s. "The Exit from Industry: a Survey of the Provision for Old Age and for Retirement from Gain Occupation in the United Kingdom, together with Proposals for a National Retirement Pensions Scheme, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning)". Pp. 52. 1s. (P E P, 16 Queen Anne's Gate, S W 1, 1935.)

The proposals of the second report are no less attractive They visualise the extension of the compulsory contributory old age pensions scheme so as to provide retirement pensions at the age of sixty-five years or later (at the option of the individual) The finance of the pensions scheme is simplified by sharing the cost between the State, the employer and the worker There would be savings on unemployment benefit and assistance, etc., and taking these into account it is estimated that the net cost of the scheme at the outset would be between £20 6 millions and £22 8 millions a year Under the scheme, some 620,000 persons already retired would receive a retiring pension, and rather more than 470,000 persons still in employment would be afforded an opportunity of retiring on a pension sufficient for minimum needs, and it is estimated that at least 100,000–160,000 younger workers would in consequence be absorbed.

The case for these proposals rests, however, as much on their indirect effects as on their effect on those immediately concerned. By reducing the risk of unemployment in adult life and removing entirely the fear of destitution and dependence in old age, it alleviates two of the major causes of friction in the wage-earner's life The increased social security cannot but have a beneficial effect on the general welfare and health of the industrial population, and the steadying stimulating influence on the home market should tend to increase purchasing power, in keeping with the proved experience during the world depression of those countries which have highly developed social insurance as against those that have not

The reports submit a strong case which is all the more impressive in that they visualise the employment situation as a whole. Put in another way, they suggest ways and means by which the large increase of leisure made possible by mechanisation may be regulated so that it does not take the injurious form of unemployment. To defer the age of entry into industry and to facilitate the honourable retirement in later years is obviously only a partial cure None the less, if the estimates of the reports are approximately correct, the reduction of adult unemployment by some 600,000 persons offers a large contribution to the elimination of that hard core of unemployment, constituting about a million who are out of work for long periods, many of them wholly and permanently The exact details of the schemes now produced matter less than the broad lines of the policy of concentrating employment where it is socially most desirable and providing specially for certain categories of people so as to take them out of the industrial field without hardship and indeed with advantage to themselves The great merit of the reports is that they represent a scientific analysis of the situation upon which an alert, constructive and critical public opinion can be built up, not the least important element in which is that of scientific workers themselves

Reviews

Respiration

Respiration. By Prof. J. S. Haldane and J G Priestley. New edition Pp xiii+493+17 plates (Oxford: Clarendon Press, London: Oxford University Press, 1935.) 30*s* net.

AS is implied in the title page, the present volume is a new edition of a former work, namely, "Respiration", by Prof. J. S. Haldane, published by the Yale University Press. Even in the title page, there are quite a number of changes as between the present work and the former one At the outset, the Clarendon Press is to be congratulated upon the production of an attractive volume, and the original author is to be congratulated on having secured the help of Dr. Priestley. Nor must it be forgotten that Priestley's collaboration in authorship has a particular appropriateness, for Priestley was Haldane's helpmate in the particular research which in one sense formed the climax of Haldane's work, the discovery of a simple method for the analysis of alveolar air and the consequent investigation of the effect of carbonic acid on respiration

I have used the word "climax" above, but I am not sure that it is the right word · to ascend a summit, from the top of which new and unexplored territories stretch out— Is that reaching a "climax"? Never mind the book reduced to its simplest terms is the account of the ascent of that summit and the subsequent exploration of the promised land which revealed itself from the top That, as I say, is the book reduced to its simplest terms , but it cannot be reduced to very simple terms In writing a novel, it is possible to work the subsidiary love affairs of the subsidiary characters into the whole theme, because the author has a perfectly free hand But with Prof Haldane it is otherwise , he has for most of his life been in some sense a public servant—a gas referee or an expert called in by this or that Government Department The themes at which he has worked have often been thrust upon him by some public urgency, and necessarily appear as somewhat detached issues in the book Their unity with the whole is to be found less in the subjects themselves than in the treatment of them all by the same master mind

In a new edition, it is natural to seek for the fresh material that has been grafted on to its predecessor In this connexion the reader will be much interested in Chapter iv, in which he will find Prof Haldane's views on osmotic pressure set out in an attractive way The cleavage between the present author and previously unchallenged views is expressed in the following sentence · "It was shown quite clearly by Haldane, that van 't Hoff's conception of osmotic pressure was mistaken It is neither the concentration per litre of the solute molecules, nor that of the solvent molecules which determines osmosis, but the diffusion pressure of the solvent Water passes through a semi-permeable membrane into a solution because the diffusion pressure of pure water is greater than that of the diluted water in the solution The osmotic pressure is not the excess of the diffusion pressure outside the solution, but the external mechanical pressure required to equalise the two diffusion pressures"

Another very important chapter, most of the material in which is new, is Chapter xiii entitled "Air of Abnormal Composition" It treats of such subjects as the town air, that of occupied rooms, the discomforts of warm and cold air, escapes of gas, mine air containing various impurities including dust, the air of sewers and ships and of tunnels In this chapter will be found much of the lore which Haldane has accumulated during his investigations into such matters as the safety of the Mersey Tunnel or miner's phthisis

It is not to be thought, however, that these chapters are the only important additions , the whole book has been brought up to date, and should be on the shelf of anyone who seeks up-to-date information on almost any matter connected with respiration J B.

Arts of West Africa

Arts of West Africa (Excluding Music) Edited by Michael E Sadler (Published for the International Institute of African Languages and Cultures) Pp xi+101+32 plates (London Oxford University Press, 1935) 5*s* net

RECENT exhibitions of the art of Indian, Chinese, African and 'primitive' peoples, such as that of the Burlington Fine Arts Club (see p 927), have afforded the British public an opportunity of judging at first hand the merits of non-European achievement in this field The exhibits were, no doubt, to many something of a surprise The exhibition of African art was supplemented by the simultaneous publication of "Arts of West Africa", which enables those who are not acquainted with the literature dealing with African art, by now becoming extensive, though of unequal value, to taste the quality of this exotic production at their leisure It had, however, a more serious purpose Its publication was suggested in the course of discussions of the Committee on Education of the Colonial Office and was intended to vindicate African art, as something more than a 'bush' product, in the eyes of those who are interested in the West African and more especially those, administrators and others, who are in a position to influence the course of his future development.

The volume is by several hands The most substantial contribution is by the editor, Sir Michael Sadler, who writes on "The Significance and Vitality of African Art" and is also responsible for the bibliography Sir William Rothenstein has written a foreword, and the educational aspects of African art are considered by Mr G A Stevens, formerly head of the Art Department of Achimota College, Gold Coast Colony, and Mr Gabriel Pippet, also a member of the staff of that institution, who describes his methods of utilising the services of a native craftsman in teaching woodcarving. The principal feature of the book, however, is the thirty-two plates with descriptive notes of each object figured by Mr Richard Carline

The examples of African art here shown are sculptured human figures and masks, all in wood, with one exception, which is of pottery, decorated bowls of wood or pottery, and musical instruments, utensils, stools, etc., of wood, metal or gourd, all showing characteristic employment of art motifs for decorative effect.

The area from which the examples shown are drawn is almost exclusively British territory, although, as Sir Michael points out, the whole of West Africa forms a single artistic province, including indeed differentiated local schools, but to be distinguished as a whole from the rest of Africa. The virtual restriction to British West Africa has excluded some of the most striking and æsthetically notable of the sculptures; but the examples given here are so far typical as to afford ample evidence by which to test the high estimate of the merits of African art formed by European critics. They will also enable those open to conviction to appreciate it as something more than merely grotesque and bizarre and as worthy of serious study as an expression of a real and strong emotional reaction to reality, in forms which may be denominated 'art' in the more conventional sense of that term.

It is precisely here that difficulty arises in any attempt to develop the artistic genius of the African along lines in harmony with his bent as exhibited in this tradition. African art, as known in the examples which have attained the high standard of æsthetic appreciation, belongs to the past. It is the product of a pagan environment, a product of a religious and ethical background which has now passed, or is passing, before the onset of white civilisation and the Christian religion. Surprise has been expressed that the anthropologist collecting examples of African art as ethnographical specimens should have chosen those which almost universally were æsthetically right, according to the standards of the critics. The explanation is that to the anthropologist this is no primitive art, as it is conventionally regarded, but an art which is the product of a long course of cultural development, in which emotional expression, technique and cultural environment generally have attained a certain state of equilibrium, susceptible of definition. His choice has fallen advisedly, therefore, on those specimens which seem most perfectly to exemplify that equilibrium and to display most completely the ethos of the people, their 'soul', as well as their highest and most characteristic technical accomplishment. In African art it combines a religious or magical symbolism, expressed through representation of natural forms, with a disposition of mass and line which displays a remarkable feeling for pattern, but is conditioned by the technique of the knife. The importance of this technique in the production of characteristic forms is indicated by Mr. Pippet's experiment in employing a native demonstrator for teaching wood-carving.

In so far as the aim is representation, African art is crude and imperfect, whatever may be its unconscious success as abstract art. The anthropologist who regards these matters, not from the point of view of abstract art, but in terms of culture, and in so far as his studies have practical application with the view of cultural development, may well question, now that the state of equilibrium has been disturbed, whether the elimination of crudities and imperfections of technique, as well as the suppression or transformation of the central emotional inspiration, may not also eliminate the artistic feeling for pattern and design. More often than not, in European children, the process of perfecting eradicates the capacity to charm found in the *naïveté* of their early efforts, to which Sir William Rothenstein compares the appeal of African art.

A Base-Less Fabric

The Natural Logarithm. By Sir Charles Vernon Boys. Pp. 31. (London: Wightman and Co., Ltd., 1935.) 2*s*.

NO practical man ever saw the least difficulty either in the idea of logarithms to a given base or in the use of common logarithms in arithmetical work. But if the practical man becomes inquisitive as to the methods by which his tables have been computed for him, or if he has to learn the use of logarithms in integration, the mathematician takes him seriously in hand; a quarter of a century ago, he was plunged into uncongenial algebraical analysis, into which the mysterious *e* was introduced dogmatically; nowadays, he is more likely to be told that the logarithm is defined as an integral, and to be set the bewildering task of pretending that he has never used a logarithm in his life. Sir Charles Boys, in his younger days, met with the first fate, and for a long time the natural logarithm seemed to him utterly artificial. Now he has found a direct line of approach, and he has written a tract which he tells us he would have swallowed whole if it could have been given to him when he was trying to digest Todhunter's account of the exponential series.

The interesting fact is that Sir Charles Boys has really turned, like the pure mathematicians, to the integral: his central investigation concerns the area under an arc of the rectangular hyperbola $y = 1/x$. But there is a difference. Having found, by a simple geometrical argument, that the area under an arc depends only on the ratio of the abscissæ of the end-points, the practical man is satisfied to recognise that the areas *are* logarithms, to some base or other. He finds that he can calculate these logarithms, and the value of the base does not interest him. patently, the values of these logarithms are what he wants in integration, while if he wants logarithms to base 10 he has only to divide his areal logarithms all by the same constant, namely, the areal logarithm of 10 itself.

The crucial stage then is to devise a process of calculation. Sir Charles Boys gives Archimedes' quadrature of the parabola, and replaces the hyperbolic arc by an arc of a parabola. He shows that even the simple choice of the parabola which touches the hyperbola at the two end-points of the arc gives an approximate logarithm accurate to 1 in 10^7 if the argument is between 1·0 and 1·1. This parabola lies inside the hyperbola, and the approximation is necessarily in excess. An obvious modification is to introduce a parabola which crosses the hyperbola and allows some compensation of errors, and Sir Charles makes an ingenious choice which, without adding substantially to the arithmetic, reduces the error from 1 in 10^7 to 1 in 10^{11}.

The weakness of the presentation is that both to determine the best parabola and to estimate the error Sir Charles uses the classical logarithmic series. If, after all, we are dependent on this series, the work becomes on the arithmetical side a mere curiosity. The classical series, as the author shows—though not in the language a mathematician would use—follows at once from the identification of the logarithm with the area, and since obviously the series *could* be used for calculation, the question whether the existing tables were actually calculated as efficiently as they might have been is of no practical importance. The practical man does not want to recalculate logarithms of any kind, but he does want to understand the natural logarithm, and this tract will show him very clearly how natural it is. On p. 22, H^2 and A^2 should be H_2 and A_2.

E. H. N.

Scientific Study of Dust

Dust. By Dr. S. Cyril Blacktin. Pp. xi+296+2 plates. (London: Chapman and Hall, Ltd., 1934.) 18*s.* net.

DR. BLACKTIN has written a book which is a mixture of philosophy and fact. In modern days this is unusual in a scientific textbook, and initially makes rather interesting reading. The scientific reader in search of a lucid exposition of dusts and smokes, however, will find it rather difficult to differentiate between the facts and Dr. Blacktin's own philosophy. The author has considered every conceivable aspect of smokes and dusts, even explaining how they help in the scientific detection of crime. (Under the heading of dusts he includes such widely diverse systems as sandstorms, volcanic eruptions and ice particles.)

One is left with the impression after reading the book, however, that Dr. Blacktin would have done well to have specialised more on the scientific and technological applications of the subject, rather than to have dwelt on a large number of extraordinarily interesting and out of the way facts, which are somewhat irrelevant to the scientific investigation of atmospheric pollution or its allied problems.

The author has also introduced a new nomenclature, and a new set of definitions which, as the old ones of Gibbs (depending upon size) have been in general use for some years, is to be regretted, especially as the new ones are founded more on assumption of certain properties of particles than on fact. Most workers will disagree strongly with some of the definitions and statements. Thus—taking only one example, for the book provides much material for polemical discussion—Dr. Blacktin's definition of the difference between a smoke and a dust is that the latter is a disperse system in which the individual particles are breaking up and becoming smaller, due to a self-abrasive or disruptive approach action, whilst in the former the particulate matter is increasing in size, due to coagulation. There is no doubt of course about coagulation, but almost certainly this process continues until the particles are so heavy that they fall out under gravity. All the experimental and theoretical evidence is against a change in which disintegration commences and the particles become more numerous. Nor is there any evidence of an equilibrium state which would exist if Dr. Blacktin's views were correct. The coagulation of a smoke system, of course, becomes very slow as the particles get larger and less numerous, but this is due to the lack of Brownian diffusion and hence the small chance of collision, which also suggests the remoteness of the possibility of self-abrasive action in dusts of larger particle size.

Dr. Blacktin's book, however, will be valuable as a guide to industrial and technological workers. There is no phase of the subject on which he has not touched, in industry, in physiology or in Nature. He has also included an invaluable collection of almost six hundred references, and the work will be useful as a book of reference on the subject to the reader who has little or no previous knowledge of dusts. One criticism the reviewer must make is that he has found the English very obscure in places; this is a very real blemish in a book of this description.

Short Notices

Scottish Folk-Lore and Folk Life Studies in Race, Culture and Tradition By Donald A. Mackenzie. Pp. ix+310. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1935.) 10s. 6d. net.

MR. MACKENZIE gives his readers a comprehensive view of the main heads of Scottish folk-tradition and belief. He ranges from food taboos to giants, fairies and goddesses. One of the more remarkable of the topics with which he deals is the attitude of the Scottish people towards the pig. Among the other peoples of Britain it has always been more or less a staple article of diet, but in Scotland, although there is evidence that it was eaten and was a victim in sacrifice, generally, or at least widely, it has been avoided as an article of food. Mr. Mackenzie holds that this attitude is pre-Christian, and derives it from the East, whence he thinks it may have been taken by the eastern Celts from Attis worship and the legend of the slaying of the god by a boar.

Current theories on the Celtic (or 'Keltic') question find little favour with the author, and he will not tolerate views which make Scotland dependent upon Ireland. In race and in folk lore and tradition, he argues strongly for the individuality of Scotland, which he maintains has developed on the whole with singular freedom from alien influence. On the other hand, he seeks to show that in such matters as the food taboo, already mentioned, and the belief in mother-goddesses, there is cogent evidence of a cultural diffusion from the East. Mr. Mackenzie might have been more convincing had his treatment been more systematic, and loose statements and slips less frequent. "Alpine" and "Armenoid", for example, as racial terms are not interchangeable. La Tène is not "early" Iron Age and "the late Mr. Gray" could not have measured 5,000 recruits during the War, as, to the regret of his friends, he died two years before it began.

New Light on Old Masters By Prof. A. P. Laurie. Pp. 163+12 plates. (London: The Sheldon Press; New York: The Macmillan Co., 1935.) 6s. net.

IN this book, miraculously compressed to a modest 163 pages, is summarised that fund of information on the painter's methods and materials so authoritatively expounded in Prof. Laurie's earlier volumes. To effect this sweeping condensation, without sacrificing the scientific and historical approach, must have been extraordinarily difficult; but Prof. Laurie, by pursuing the substance rather than the form, has contrived not only to retain practically every significant fact from his earlier works, but also to introduce many new ones. Obviously, he has made certain unwilling sacrifices of style and spaciousness: occasionally, an argument has been so condensed as to lead perilously near to a brilliant *non sequitur*. But his matter is intensely interesting.

A concise opening survey of the development of the palette precedes a description of Italian quattrocento painting methods, as set forth in the "Libro dell' Arte" of Cennino Cennini, and a later chapter on the Van Eyck technique is particularly good. The final section, on scientific examination of paintings—a field wherein Prof. Laurie has been a bold pioneer—is illustrated by references to actual problems encountered. One could wish that the author had underlined more heavily the present limitations of certain scientific weapons: for many who should know better tend nowadays to regard, for example, X-ray examination of any painting as an unfailing criterion of pedigree, provenance and general respectability.

P. D. R.

The Neural Basis of Thought By George G. Campion and Sir Grafton Elliot-Smith. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vi+167. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1934.) 9s. net.

THIS book takes its stand on the view that the terms which are used in thinking processes are constantly changing and developing, and in reality display none of that fixity which has sometimes been considered to be the main characteristic of the 'concept'. It is suggested that this is due to the fact that the material of thought is always being influenced by affective or emotional responses. Head and Holmes have demonstrated that in "some way the essential organs of the thalami are the centre of consciousness for the affective side of sensation". There are, as is well-known, innumerable paths of connexion between the thalami and the cortex. The authors hold that these "are return paths for reflex neural impulses from the cortex which excite relay cells in the thalami, and that these relay cells in turn send stimuli both to the essential thalamic organs and also to the same cortical areas from which the paths conveying the return impulse originated". Hence it is argued that thought processes must be pictured as based upon a constantly circulating stream of neural impulse from cortex to thalami and from thalami to cortex.

Measures and Weights By Sir Flinders Petrie. Pp. x+22. (London: Methuen and Co., Ltd., 1934.) 2s. net.

IN this little book, Sir Flinders Petrie returns with the added experience of his excavations in southern Palestine to a subject of which he has always stressed the significance. "The study of ancient measures used in a country," he says here, "is a basis for discovering the movements of civilization between countries. The study of ancient weights serves to show the trade connections at any given period." Beyond his introductory remarks, however, Sir Flinders does not discuss the general principles, with which he has dealt elsewhere, but outlines the subject only for ready reference as to detail in the practical work of the archæologist.

Systems of Echo Sounding

THE recent revival in shipbuilding has re-awakened interest in various items of ship equipment One of the most important of these developments has taken place in the methods of sounding, and it has recently been stated, by a high authority in these matters, that no modern ship could be considered properly equipped without the fitting of echo sounding It is the purpose of this article to review briefly the principal systems at present in use, and to attempt to draw a fair comparison between them

The first suggestion that submarine depths could be measured by determining the time interval between the moment of transmission and the return of the echo, appears to have been made by Arago in 1807 In 1855, Lieut M F Maury, of the U S Navy, who devoted particular attention to navigation and meteorology, made unsuccessful experiments designed to realise the method in practice

The loss of the *Titanic* in 1912 prompted Richardson to formulate a similar suggestion in more explicit form This, together with the general growth of shipping, stimulated workers in various countries It is undoubtedly a fact that work on submarine listening during the War did much to lay the basis for the technique required to develop a genuine aid to navigation Although it is reported that Behm succeeded in measuring depths in Lake Ploen in 1912, it was not until January 1923 that the first public report made by the Director of the French Hydrographic Service showed that this new and indirect method of measurement was well adapted to practical needs This report was to the effect that a line of soundings had been run across the Mediterranean in April 1922 in connexion with a projected submarine cable In June 1922, the U S.S. *Stewart* obtained a line of echo soundings across the Atlantic from the American coast to Gibraltar, and continued the line of soundings from Gibraltar to Port Said in July 1922. This apparatus was designed by Dr. H C Hayes, of the U S Navy Within a year or two, every important maritime country in the world had announced the completion of successful trials of echo sounding apparatus of one sort or another

FIG 1 Indicator employed with Admiralty High Frequency Gear

FIG 2 Fathometer Indicator, Universal Type, 432

The method of initiating the pulse of a sound and receiving the echo and measuring the time interval between the two events may be considered broadly under two distinct headings —

(*A*) THE SONIC SYSTEM In this case, (1) a steel hammer strikes a steel plate in the bottom of the ship and sends out a highly damped compressional wave (This method has been used by the British Admiralty, and 'Fathometer') (2) A Fessenden, or similar oscillator, sends out a short pulse of sound at a frequency of a few thousand cycles per second (This method is also used by 'Fathometer') (3) Detonation of an explosive ; for moderate depths a gun may be fired at the surface of the water, or for greater depths, the charge may be exploded beneath the surface (Behm)

(*B*) THE SUPER-SONIC SYSTEM In this system a high-frequency oscillator is employed giving a beam of sound waves up to as much as 30,000 or 40,000 cycles per second This sound wave is of such high frequency that it is inaudible to the human ear There are two principal systems which employ this method ·

(1) The Langevan-Chilowsky system. This employs a quartz mosaic between two steel plates of such thickness that the fundamental frequency of vibration is of the order of 30,000 or 40,000

cycles per second. A suitably cut quartz plate possesses the property of expanding when an electric field is applied in one direction and contracting when the field is reversed The application of an oscillatory condenser discharge to the quartz plates produces an oscillatory mechanical movement of the steel plates As the radiating surface is several wave-lengths in diameter, a sound-beam is produced

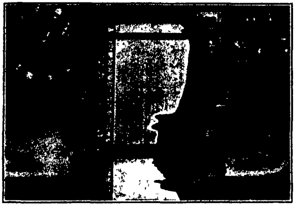

FIG 3 Contour being drawn by 'straight line' recording gear

(2) The British Admiralty high-frequency system This employs a laminated structure of nickel with a resonant frequency of approximately 16,000 cycles per second Nickel possesses the property of contracting in an increasing magnetic field and increasing in length in a diminishing field The laminated structure constitutes a closed magnetic circuit provided with a toroidal winding, so that an oscillatory condenser discharge through the windings sets up an oscillatory magnetic field in the nickel, and produces corresponding mechanical vibrations. The vibrations are concentrated into a beam of about 45° angle

It must not be judged from the foregoing description that all of the devices enumerated are equally well-adapted to every purpose. For example, the non-directional properties of the sonic system necessitates that the hydrophone or receiver be comparatively remote from the transmitter in order that the latter part of the transmission may not interfere with the front part of the returning wave train, especially in moderate depths of say 10 fathoms. This separation has the effect of compressing the scale at its lower end, rendering precise readings more difficult just where precision is sometimes most needed. The short wave train and the directional properties of supersonic systems both enable the transmitter and receiver to be placed close together, and under favourable conditions makes possible readings to within a foot or so of the keel, at least in the case of the Admiralty magneto-striction system

A further advantage of the use of a supersonic frequency is that the tuned receiver is less subject to disturbance from water-noise and general ship's noises than is the case at lower frequencies

On the other hand, low-frequency sounds are less subject to attenuation in passing through the hull of the ship and also in passing through great depths In the case of the Langevan-Florisson system (30,000–40,000 cycles per second) it is necessary to cut a hole in the bottom of the ship and transmit through a thin diaphragm, and even then it is not considered practical to apply this system to depths greater than 750 fathoms In contrast to this, sonic systems have been employed to sound the greatest ocean depths The Admiralty high-frequency magneto-striction system (about 16,000 cycles per second) combines to a great extent the advantages of both sonic and supersonic systems and is employed without the necessity for cutting the ship Depths of more than 1,000 fathoms have been sounded by this system, transmitting and receiving through a ⅝ in thick steel hull, and the echo was then of such an intensity as to hold every promise of taking soundings in the greatest ocean depths The following comments upon this system are made in a paper on "The Fiord Region of East Greenland", by Louise A Boyd, published recently by the American Geographical Society —

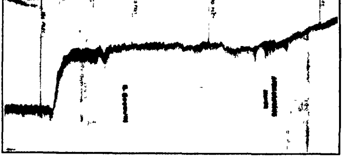

FIG. 4 Record on Admiralty "Challenger" magneto-striction recorder Minute time scale along water line Speed of ship, 22 knots

"This installation represented the very latest development in ultra sonic depth-measuring technique, and the trial showed that its efficiency was greater than that of any previous apparatus of the same size and type In the tests off the Lofoten-Vesteraalen islands not only were the desired 1800 meters obtained, but approximately 2200 metres (1200 fathoms). Reaching that depth, the ocean bottom leveled off, and the instrument was still recording vigorously when we turned back toward shore"

The question of accurately recording the time interval between transmission and reception of a sound pulse raises difficulties of considerable magnitude, when the speed of sound in water is approximately 4,800 ft per second, this means that a depth of 400 fathoms (allowing for the double effect of the reflected sounds) corresponds to one echo-second In other words, on whatever scale may be selected for recording the depth, changes of one foot must be made by the recording agent in a 2400th of a second It is easy to see that to do this with precision involves immense care and thought in design

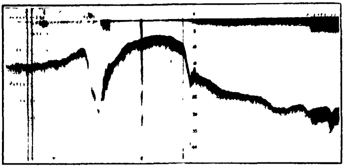

FIG 5 Shallow water record

Many devices have been brought out to achieve this result The earliest method was to make a scale of feet or fathoms with the full limit of the depth required marked on it in the smallest readable markings The original scale of the British Admiralty listening gear was a circular drum 12 in in diameter, on which 130 fathoms was scaled to feet markings or half fathoms The light flashing scales of the Fathometer and Langevan gear can also be scaled to ½ fathoms

The latest form of indicator employed with the Admiralty High Frequency System is normally scaled to half fathoms, but a recent installation had a scale of 50 fathoms on which 1 foot = 0·1 in, and on this scale, a change of depth of 1 foot could easily be detected Fig 1 illustrates this instrument, which is well adapted to use on the bridge, being the 'indicator type' in which a pointer moves over a large dial with a convenient open scale, and remains steady at the depth, only moving as the slight changes of echo time impel the needle.

For navigation the echo sounder was employed originally to delineate the 100 fathom line, and it was accepted by the ships' officers in the early stages for the purpose of getting the check on position Recently, the interest taken by the shipowner has greatly enlarged its usefulness in the direction of lesser depths, with the view of preventing grounding or straining the ship when passing through channels or mouths of rivers where mud and silt have made the depth of the fairway uncertain to a few feet The demand for shallow depths has become so acute that the reading of 3 feet under the bottom will become an essential of echo sounding

The Fathometer light-flashing scale gives deep and shallow readings within coarse limits by employing two speeds for the flash as it travels round a circular dial (Fig 2), but the light-flashing method cannot be read to sufficient accuracy to ensure a ship passing over a bar within an accuracy of one foot

The best method of reading very shallow depths is by large-scale recording, and a method has been recently introduced in which 1 ft = ⅛ in This machine would enable a ship to pass over a bar within 1 foot of the bottom with absolute accuracy A 2-speed gear would enable the scale to be decreased ten times, thus enabling the gear to be used either for shallow or deep echo sounding.

RECORDING GEAR

The most effective type of recording gear up to the present time has been the British Admiralty pattern on which the echo depth is marked by a pen moving on a straight path by means of a cam motion. The record paper is fed over a wet wick, and the echo signal marks the paper, which is impregnated with starch-iodine. This method, which can be called straight line recording, has a uniform scale and gives a true picture of the shape or contour of the bottom (Fig 3): but it must be observed that the records cannot be described as true to scale, because the rate of movement of

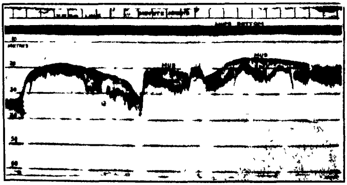

FIG 6 Record showing mud surface and under surface of rock

the ship is much greater than that of the record paper on the scale of depth For example, a ship moving at 15 knots will travel 1,500 feet per minute, and even if the record paper were fed at the rate of 3 inches per minute, the maximum width of the paper is only 5 inches for a depth of 100 fathoms or 600 feet

This compression of distance, however, is not a disadvantage, as it only tends to exaggerate the contour, and a hole or bank will be indicated with a steeper rise or fall, say, in the proportion of 3 or 5 to 1, according to the speed of the ship (Fig 4)

Fig 5 is taken from the British Admiralty pattern boat gear, which operates on precisely the same principle as the *Challenger*, but is specially adapted for shallow water It will be seen from this diagram that a very great degree of accuracy in exceedingly shallow water can be obtained

ADVANTAGES AND DISADVANTAGES OF CERTAIN TYPES OF DISTORTION

The desirability of avoiding the compression of the scale near the zero due to the large separation entailed by the use of sonic systems has already been mentioned. Another form of distortion is introduced by recorders of the Fathometer type, in which the stylus traverses the paper along the arc of a circle. A line of soundings obtained over a symmetrical bank produces a record on which the bank appears to be inclined toward the centre of curvature of the stylus path Soundings taken along the same line but in the opposite direction will incline the bank in the opposite direction with reference to neighbouring features on the chart. The Admiralty chemical recorder, on the other hand, due to the rectilinear path of the stylus produces a symmetrical record of a symmetrical bank, and gives a faithful record of any irregularities in the sea bottom passing along the same line in either direction Fig 6 illustrates the accuracy with which this method can detect the nature of the bottom, showing the two echoes that can be obtained, (1) from the soft initial surface of mud, and (2) from the under surface of rock By an ingenious method of phasing, it is possible, in this instrument, to retain an open scale and at the same time read up to very considerable depths , for example, in one instrument a scale of 90 fathoms to 5 inches or 18 fathoms per inch can be retained, while by phasing, soundings up to 250 fathoms can be taken Fig 7 shows a typical example of this In studying this chart and applying the figures written on the chart, it will be seen that the sections of slope can be added on to one another to give a true representation of the formation of the bottom This is not, of course, actually necessary when the 100 fathom phase is applied

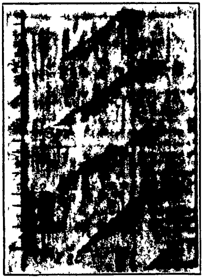

FIG 7 Example of sounding by phasing

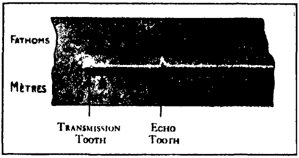

FIG 8 Scales of light flash echo-meter

INDICATORS

In the combined recording and indicating bridge instrument supplied by the Submarine Signalling Company, a light travels round a dial in eclipse and flashes out at the moment the echo is received In the 'Echo-Meter' "Marconi" (Fig 8) a curved scale is employed and a flashing light is given a uniform velocity along the scale, and flashes up in a small peak at transmission and again when echo occurs Thus it is possible, as these flashes take place with great frequency, to read roughly the echo distance or depth on the scale. From the point of view of the bridge officer, the use of light for 'indicating' is open to certain objections , in the first place, on a bright day it is difficult to see, and conversely at night it is not advisable for eyes that have to look out into the darkness also to have to watch a small flashing light on the bridge. In this respect the Admiralty pattern indicator (Fig 1) seems to have distinct advantages, where a simple pointer on a dial is employed, which is dimly illuminated at night.

Echo sounding, as an item of standard equipment, has now definitely come into being, and there is little doubt that with increased experience ships' officers will become more familiar with the technique of using this instrument As a result, an immensely increased and much more accurate knowledge of the conformation of the bottom of the sea, particularly on regular routes, will be developed; and navigators will find more and more that they can determine their position accurately by this means.

Fossils as Indicators of Continental Drift*

By SIR ARTHUR SMITH WOODWARD, F R S

STUDENTS of fossils are interested in Wegener's theory that the continents are floating on a heavier layer of the earth's crust which, sometimes at least, becomes plastic and allows them to move through different longitudes and latitudes If there has been such movement during geological time, this may clearly explain the changes of climate in many areas to which fossils bear witness It affords a possible reason for the occurrence of plants and animals of temperate or even subtropical habit among the fossils found in the present arctic and antarctic regions It also perhaps shows why the land and fresh-water life of the coal period throughout the northern hemisphere was so remarkably uniform

The use of fossils, however, in testing Wegener's theory and in determining former land connexions is not so simple as it might at first appear For example, some who have noted the remarkable similarity between the graptolites in the earlier Palæozoic rocks on the two sides of the Atlantic have concluded that western Europe and eastern North America must have been close together when these graptolites lived in a continuous shallow sea Others, who have studied also the associated life, have decided that the two areas in question were already separated in Cambrian to Silurian times by a great Atlantic Ocean in which sargasso seas sent forth both to the east and to the west the same floating organisms There are thus two equally plausible interpretations of the facts, one in favour of Wegener's idea that during the Palæozoic era the continental lands were continuous, while the other points to the immense antiquity and the permanence of at least one ocean basin

Again, the extensive and nearly uniform distribution of many of the Devonian fishes, which must have lived chiefly in fresh-water lakes and rivers, seems remarkable if the continental areas in the Devonian period were as widely separated as they are at present It must, however, be remembered that there were already other fishes in the contemporary seas, and certain sporadic fossils suggest that the normally fresh-water forms could also live in the sea, like the existing sturgeons In this case, they could spread along the coasts and attain their strangely wide distribution even if the lands were arranged approximately as they are at the present day

There is also the great difficulty, that many fossils which look superficially alike and might be regarded as nearly identical, are really parallel developments from common ancestors This has been recognised for many years by those who have studied molluscan and brachiopod shells, and it is now becoming familiar to those who investigate other groups The principle is perhaps most easily understood by reference to discoveries of fossil mammals in North America

The early Tertiary ancestors of the camels in North America were small animals shaped like gazelles with pointed hoofs According to Prof W B. Scott, they divided into two distinct groups, one adapted for browsing on shrubs and trees, the other adapted for grazing Afterwards, the toes in each of these two groups became blunt, and the characteristic cushioned foot of the modern camels was developed The camel foot therefore arose independently in at least two separate lines derived from the same stock. According to Prof. H F. Osborn and others, the Tertiary ancestors of the horses and rhinoceroses in North America also show parallel lines of evolution The gradual approach to the one-toed foot of the horses and to the horned snout of the rhinoceroses occurred in several distinct groups at the same time, though sometimes at different rates Prof. Osborn has also pointed out, in his recent great work on the Titanotheres, that these massive horned mammals, which flourished during the middle of the Tertiary era, evolved on several distinct lines, and independently acquired horns and other features which were approximately the same

Remembering these facts, it is interesting to consider some of the fossil animals which have actually been regarded as proving former connexions of some kind between lands which are now well separated.

The skeletons of certain fossil Sparassodonts found in the Lower Tertiary deposits in Patagonia are so similar to the skeleton of the marsupial Thylacine now living in Tasmania, that these animals have sometimes been referred to the same family. They have therefore been interpreted as indicating a former direct connexion between South America and the Australian region. In their palate and successional teeth, however, the Sparassodonts are more nearly similar to some of the early Tertiary primitive Carnivores known as Creodonts, which lived in the northern hemisphere and might well be regarded as also the ancestors of the Australian Thylacine. The Sparassodonts and the Thylacine, therefore, may be merely parallel developments from the same northern source, which migrated southwards by two different land-routes to the remote, widely-separated areas where they are now found.

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* Extended account of a contribution to the discussion on "Wegener's Hypothesis of Continental Drift" at the meeting of the Geological Society of London on January 23, 1935

Among the fossils discovered in late superficial deposits in Australia and some adjacent islands, there are species of a peculiar horned tortoise, *Miolania*, which has the tail armoured with rings of bone. A nearly similar tortoise, which has been referred even to the same genus by some authors, occurs in a rock of uncertain age in Chubut, Patagonia. Here again, at first sight, there seems to be evidence of a former direct connexion with the Australian region and South America. *Miolania*, however, belongs to a sub-order of Chelonians which had a very wide distribution over the northern hemisphere before it became specially characteristic of southern lands. The species found in Australia and South America may therefore be merely independent offshoots of the same source which have retreated south by different routes.

The same explanation almost certainly applies to the little Mesosaurian reptiles which are found in the Permian rocks of South America and South Africa, and have been quoted as part of the evidence that at the end of the Palæozoic era these two lands were directly connected. In the Coal Measures of both North America and Europe, which represent a somewhat earlier geological period, there are ancestors from which the Mesosaurians were possibly derived; and these reptiles may have gone south in parallel ways down the African and American continents. Similarly, the Dicynodont reptiles, which occur in slightly later rocks in both countries, may have wandered southwards independently, for they are known to have been distributed at the time over Europe, Asia and North America. These fossils therefore do not help to prove that South America and South Africa formed a continuous land when the reptiles in question were living; and the recent discovery of numerous large Rhynchosauria in the same rocks in southern Brazil suggests that there was no such land-connexion, because no trace of these reptiles has been found in the well-explored corresponding rocks in South Africa.

It is thus evident that when former changes in land-connexions are being discussed, it is not enough merely to compare lists of fossils. The precise relationships of each fossil need first to be determined so far as possible; and even if this precision can be reached, there are often alternative interpretations which have to be considered.

Obituary

PROF. H. B. BAKER, C.B.E., F.R.S.

THE recent death of Herbert Brereton Baker removes a familiar name from the roll of chemists who made their reputation before the opening of the present century. He was born on June 25, 1862, as the second son of the Rev. John Baker, curate-in-charge at Livesey, near Blackburn—a district in which the distress arising from the cotton famine was then intense, and the relief of which was a real concern of the Baker family. After a period of schooling at Blackburn, both boys were enabled, by sacrifice and rigid economy on the part of their parents, to become pupils at Manchester Grammar School. Beginning on the classical side, young Baker turned over to science, securing later a scholarship at Balliol, as well as a Brackenbury school scholarship. The teaching of chemistry at the Manchester Grammar School was then in the capable hands of Francis Jones, and Baker was always ready to acknowledge his debt to one whom he termed "the best of all teachers".

Baker's tutor at Oxford was H. B. Dixon, and the enthusiasm for investigation which the senior man possessed in an eminent degree was communicated to his pupil. After taking a first class in natural science, Baker was appointed demonstrator at Balliol and private assistant to Dixon; an association which led him to the main investigations of his life—the effect of moisture on chemical change.

In 1884 Baker was appointed chemistry master at Dulwich College, and on his initiative a science side was developed on the same lines as at Manchester. The chemistry department at Dulwich had already some tradition of research, and equipment for such work had been provided by Baker's predecessor, Alfred Tribe, best known, perhaps, as a collaborator with J. H. Gladstone. The tradition was more than maintained by Baker, and, in spite of heavy teaching duties, he published during this period a great deal of the work with which his name is specially associated. It is indeed a remarkable fact that Baker was elected a fellow of the Royal Society in 1902, while he was still a schoolmaster

After a short period as headmaster of Alleyn's School, he returned in 1903 to Oxford, succeeding Vernon Harcourt as Dr Lee's reader at Christ Church To a man of Baker's temperament the opportunities offered by such a post were naturally more attractive than the administration of a large school, and he took a prominent part in the long overdue reorganisation of the teaching of chemistry at Oxford

In 1912, the year in which the Chemical Society awarded him the Longstaff Medal, Baker was appointed to the directorship of the Chemistry Department of the Imperial College of Science and Technology in succession to Sir Edward Thorpe, and this post he occupied until his retirement in 1932 It was not long before the placid course of academic teaching and research was rudely disturbed by the outbreak of war, and Baker was one of the first chemists called on in 1915 to deal with the serious problems of gas warfare, in this field he rendered distinguished service, taking a prominent part in devising measures of protection against poison gas, specially phosgene His work was recognised by the award of the C B E.

The War over, Baker returned to the administration of a department overflowing with students, and to the research work in which his interests mainly lay His position as one of the leaders of British chemistry was afterwards recognised by the award of the Davy Medal of the Royal Society in 1923, and by his election as president of the Chemical Society for the period 1926–28 Apart from his special scientific interests, Baker took a share in the activities of the University of London, and served for a number of years on the Senate and its committees

Baker had married in 1905 Muriel, only daughter of H J. Powell, partner in the Whitefriars Glass Works, herself a chemist and a collaborator with her husband in various researches Mrs Baker and a daughter survive him

The starting point of Baker's life-work was Dixon's observation that a spark could be passed through a mixture of dry carbon monoxide and oxygen without any explosion occurring A natural development was the study of the effect of thorough drying in other cases of combustion, and Baker was able to show that the combination of various solid elements with oxygen at a high temperature is enormously retarded, or even prevented altogether, provided stringent measures are taken to dry the apparatus and the materials The successful distillation of phosphorus in dried oxygen was a striking case in point

Following up these early observations, Baker studied the behaviour of thoroughly dried substances which ordinarily react—in some cases violently—with one another Among the remarkable results of his drying technique was the proved absence of reaction in the following cases : (*a*) sulphur trioxide and lime, (*b*) hydrogen and chlorine, (*c*) ammonia and hydrogen chloride It was further shown that the thermal dissociation normally characteristic of ammonium chloride and mercurous chloride does not occur when the substances are thoroughly dried. Subject to the same conditions, a mixture of electrolytic hydrogen and oxygen can be heated to a high temperature without explosion or even partial combination

Many workers have attempted in vain to repeat these classical experiments Baker showed, for example, that ammonia gas, previously dried by pure quicklime, could be finally desiccated over carefully purified phosphorus pentoxide without any appreciable absorption of the gas by the pentoxide This has been frequently challenged, but it is now clear that he was entirely in the right, and that few have succeeded in reproducing his technique.

The earlier work on ammonium chloride and mercurous chloride led Baker, in collaboration with his wife, to examine the case of nitrogen trioxide As hitherto prepared, this substance invariably dissociated on evaporation, but it was now shown that the thoroughly dried liquid could be vaporised without decomposition The incidental observation that nitrogen trioxide had an abnormally high boiling point initiated an investigation into the influence of intensive drying on the physical properties of liquids generally, and in various papers and addresses to the Chemical Society between 1922 and 1929, Baker described determinations made of the boiling point, surface tension, vapour density, etc , of intensively dried liquids . many of these substances had been desiccated with phosphorus pentoxide over the War period Intensively dried benzene, for example, was found to boil 20°–30° above the normal boiling point

These remarkable observations have attracted much interest and not a little criticism That the behaviour of substances dried by Baker's technique undergoes alteration seems fairly certain, but no quantitative assessment of this change (as distinct, say, from super heating effects in the case of the boiling point) is yet available and no completely satisfactory interpretation of the phenomenon has yet been advanced

Another field of research in which Baker was active was the determination of atomic weights Tellurium, mercury and silver were cases in which collaborators under his direction applied the accurate manipulative methods of which he was a master.

Baker was first and foremost an experimentalist, and his skill in glass-blowing and other practical arts was plain to all who saw him at work. Chemical craftsmanship was his chief joy, and up to within a few weeks of his death, in spite of physical disabilities, he was to be found in his laboratory, devising and constructing apparatus for a fresh attack on old problems. Brereton Baker was a modest man of simple tastes and homely interests whose character and personality secured for him a warm place in the hearts of very many pupils and co-workers J. C. P.

WE regret to announce the death on May 14, at the age of sixty-eight years, of Prof. Edwin B. Frost, associate of the Royal Astronomical Society, and emeritus director of Yerkes Observatory.

Supplement to NATURE

No. 3422 JUNE 1, 1935

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 918.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Slowing Down of Neutrons by Protons

FERMI and his co-workers have pointed out that if a neutron source is surrounded by a material rich in hydrogen the neutrons lose energy to the protons on collision, and, after about twenty impacts, their energies are reduced to the order of those due to thermal agitation. They tried to discover whether temperature affects the density of such a neutron 'gas' by measuring the activation produced in rhodium by a neutron source surrounded by hydrogenous substances at room temperature and at 200° C. No difference in activation was detected[1].

We have performed a somewhat similar experiment by measuring the activity produced in a silver cylinder surrounding a neutron source when both were surrounded (1) by air, (2) by water at room temperature, (3) by liquid hydrogen (– 253° C.). The silver was activated to its equilibrium value, and its radioactivity was measured by an ionisation chamber and electrometer. The activities in arbitrary units on removal of the silver from the neutron source were found to be --

Arrangement	Maximum activity	Increase in activity divided by the activity produced when in air
In air	29	—
Surrounded by 1500 c.c. water in a Dewar flask	93	2·2
Surrounded by liquid hydrogen in the same Dewar flask	58	1·1

Because the silver tube separated the neutron source from the liquids, neutrons would pass through it in a manner exactly the same as when the liquids were not present. It is therefore reasonable to measure the effect of the liquids by the *increase* in activity which they produced rather than by the total activity.

The hydrogen in water has a density of 0·11 gm./c.c. while that of liquid hydrogen is 0·07 gm./c.c., that is, in a ratio 1·6 : 1 compared with a ratio of increase of activity of 2·2 : 1. The conditions were not quite so favourable for the production of radioactivity in the case of the liquid hydrogen since it was not possible to make up the loss due to evaporation, so that during the last few minutes—those most important for the activation of the silver—the volume present was less than that of the water. It would, therefore, seem probable that the measure in activation of the silver was in proportion to the density of protons which surrounded the silver and the neutron source and that it was not affected by the change in temperature.

Our thanks are due to the Union Minière du Haut Katanga for the loan of the neutron tube and to the staff of the McLennan Laboratory for help with the experiments.

J. C. MCLENNAN.
E. F. BURTON.
A. PITT.

Radium Beam Therapy Research,
London, and
McLennan Laboratory,
University of Toronto.
May 18.

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[1] *La Ricerca Scientifica*, **2**, No. 11-12, Dec. 1934.

Collisions between Neutrons and Diplons

WHEN a stream of neutrons passes through a sheet of matter, neutrons are lost from the beam both by absorption and scattering. The latter can be avoided by placing the source of neutrons in the centre of a spherical scatterer, since with this arrangement as many neutrons must be scattered into the beam as are lost from it by scattering. In these circumstances any diminution of the number of neutrons in the beam must be attributed to absorption by the material of the sphere. The usual method of estimating the intensity of a neutron beam is to measure the induced radioactivity produced in a thin layer of matter such as aluminium or rhodium by means of a tube counter. The radioactivity so produced is proportional to the length of the neutron path in the detecting substance and will be given by $k\,n\,d \sec \theta_m$ (k, number of radioactive atoms produced per cm. path, n, number of neutrons in the beam, d, thickness of the sheet; and θ_m, the mean angle of incidence).

For this reason absorption measurements using a spherical absorber do not necessarily give the true absorption, since the effect of scattering will be to increase the value of θ_m and thus increase the radioactivity produced. If each neutron is scattered several times, this secondary effect may cause an apparent *increase* in the strength of the beam by a factor as great as 2.

This secondary effect can be eliminated by using a sphere of detecting material instead of a sheet, and we have used this method to investigate the passage of fast neutrons through heavy water.

The beryllium radon source was placed at the centre of a spherical flask containing the heavy water* (98.4 per cent), the whole was surrounded by a nickel cylinder which had the small spherical detectors stuck on its inner surface. After activation, the cylinder was slipped over a cylindrical aluminium counter for measurement. The following results were obtained:

Absorber	Detector	Absorption (per cent)	Effective cross-section
D_2O	Al ($_{27}$Mg^{12})	11	7.0×10^{-24}
D_2O	Si ($_{28}$Al^{13})	15	9.7×10^{-24}
D_2O	P ($_{31}$Si^{14})	12	7.7×10^{-24}
H_2O	Al ($_{27}$Mg^{12})	13	8.4×10^{-24}
H_2O	Si ($_{28}$Al^{13})	13	8.4×10^{-24}
H_2O	P ($_{31}$Si^{14})	11	7.0×10^{-24}

The reduction in the activity of the detectors excited by the neutron beam can be accounted for in two ways: either neutrons are removed by true absorption or, after being slowed up by a collision, the neutrons are less effective in exciting artificial radioactivity.

If true absorption were a significant factor in our experiments, one would expect a marked difference between the absorption in heavy and light water; since this is not found it seems probable that the observed reduction is due to the differential slowing up of the neutrons.

Owing to the smaller mass, the velocity of neutrons is reduced by a greater amount on collision with a proton than on collision with a diplon. The simplest interpretation of our results is that the velocity excitation curve for silicon, aluminium and phosphorus rises steeply as the velocity is increased and then remains fairly independent of velocity within the range of velocities used.

That the neutrons actually do suffer a greater decrease in velocity on colliding with protons is confirmed by independent experiments on the excitation of silver (Fermi effect). As Fermi showed, silver is much more strongly excited by neutrons which have been slowed up by collision with protons than by the same neutrons before they have been scattered. We found in agreement with the experiments of Herszfinkiel, Rotblat and Zyw[1] that although the activity induced in silver is increased by passing the neutrons through heavy water, the increase is only about one third of that produced by the same amount of ordinary water.

Thus the results of our experiments can be accounted for in an elementary way as being due to the large difference in mass between the diplon and the proton.

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J. H. E. Griffiths.
L. Szilard.

Clarendon Laboratory,
Oxford.
May 17.

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* The 100 gm. of heavy water used was kindly lent to us for these experiments by the Imperial Chemical Industries, Limited.

[1] NATURE, 135, 654, April 27, 1935.

Evidence on the Velocities of 'Slow' Neutrons

We have searched in a number of ways for experimental evidence of the existence of neutrons of thermal energies, using a radon-beryllium source of fast neutrons and allowing them to diffuse through materials rich in hydrogen[1]. Until very recently we could find no such evidence, but repetition of one of our early trials, under much improved conditions, has strongly suggested the presence of such very slow neutrons.

Specimens of silver, rhodium and iodine (the last in an envelope of thin glass) were placed in turn within a long hollow paraffin wax cylinder the inner and outer radii of which were respectively 2.1 cm. and 3.7 cm. The cylinder fitted closely into a Dewar vessel which itself was surrounded by wax to a thickness of about 7 cm. The source was placed in a cavity in the outer wax. We observed the β-ray activity induced in each specimen with the whole apparatus at room temperature; the inner wax cylinder and the specimen were then cooled to the temperature of liquid oxygen (90° K.) and the observations repeated. The thermal capacity of the wax sufficed to prevent serious rise of temperature during irradiation. The specimens were allowed to regain room temperature before being presented to the counter.

The ratios of the activity induced with the wax cold to that with the wax at room temperature were found to be as follows: 1.26 ± 0.04 for silver (25 sec. period), 1.29 ± 0.04 for silver (150 sec.), 1.23 ± 0.07 for rhodium (44 sec.), but 0.84 ± 0.06 for iodine (25 min.). The change in the linear dimensions of the cylinder did not exceed 1 per cent. We conclude that an appreciable proportion of the neutrons concerned had energies comparable with those of thermal agitation, and were able to attain some measure of thermal equilibrium with the medium through which they were passing.

Fermi and his collaborators[2], using a rhodium detector in a medium of liquid hydrocarbons, have found no variation of the activity induced at 200° C. from that at room temperature. We tried with a silver detector in an oil bath up to 250° C., and found a decrease of about 20 per cent. The increase of volume of the oil due to the rise of temperature was, however, of similar order of magnitude; our result was thus inconclusive.

The difference between the behaviour of iodine and that of silver and rhodium would seem to indicate that iodine absorbs preferentially neutrons of velocities different from, and probably higher than, those which are most effective in the other cases. In this connexion we may mention that we find the absorption of 'slow' neutrons by a block of iodine to be greater for an iodine detector than for detectors either of silver or of rhodium.

The radon was generously given to us by the Radium Committee of the Medical Research Council, through Prof. S. Russ.

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J. R. Tillman.

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and Technology,
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April 12.

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[1] Fermi and others, *Ricerca Scientifica*, October 1934.

[2] *ibid.*, December 1934.

The Fermi Proton Effect in Silver

IN the course of investigating the radioactivity induced by the neutron produced by the bombardment of diplogen with diplons, we observed that the yield of radio element produced in silver increases by a factor of about ten when the sample of silver was surrounded by a layer of paraffin 3 5 cm in thickness during the exposure, showing the Fermi proton effect. The decay curve obtained with the Geiger counter is shown in Fig 1, which suggests the fact that it cannot be expressed by a single exponential curve The apparent value of half-period is about 30 sec at the beginning, becoming approximately 2 minutes at 4 minutes after the bombardment ceased

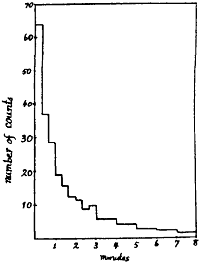

FIG 1

J Bjerge and C H Westcott have reported that the ratio of the yield of radio-element produced in silver by beryllium-radon neutrons to that by the diplogen-diplon neutron is about 100 to 15 It is generally accepted that the mean energy of the neutron is greater in the former case We have therefore two alternatives In the first case we consider the beryllium-radon neutron to contain an appreciable amount of components softer than that of the diplogen diplon neutron and these softer components were effective in the experiment of Bjerge and Westcott In the second case, the yield of radio-element produced in silver is not a monotonic function of the energy of the neutron, decreasing with decreasing energy from the region of energy of the beryllium-radon neutron to that of the diplogen diplon neutron, but below this value of energy it increases with decreasing energy In this argument it is assumed that the Fermi proton effect is due to the decrease of energy of the neutron by its collision with protons

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March 10

Radioactivity of Potassium

KLEMPERER[1] has recently shown that postulation of the existence of a radioactive isotope, ${}_{19}K^{40}$, with a large nuclear spin, affords the most likely explanation of the radioactivity of potassium He appears, however, to have over estimated the value of the nuclear spin ($i = 4$ or 5 units) necessary to obtain a sufficiently high half value period for the isotope Klemperer made use of a statement due to Gamow[2], which was based on theoretical reasoning The latter author reached the conclusion that, if two radioactive elements possess the same upper velocity limit in their β ray spectra, and if one of them suffers unit change in nuclear spin during decay while the other preserves its spin unchanged, then the ratio of their half value periods is about 100

However, if the value of 700 electron-kilovolts for the upper velocity limit of the β particles emitted by potassium is inserted in the Sargent equations between decay-constant and energy (as given by Klemperer). 250 days is obtained for the half value period on the assumption that $\Delta i = 1$, and 36 minutes on the assumption that $\Delta i = 0$ in the decay These periods stand in the ratio of 10^4, and not 10^2 From the actual curves of Sargent[3], a value of about $10^{3\,3}$ is derived for the same ratio These figures are considerably higher than that quoted by Gamow, and are probably more acceptable in view of the facts that the theory is only an approximate one and that Gamow states that the ratio may be considerably in excess of 100

On the supposition that the half value period is increased by a factor lying between $(2{,}000)^{\Delta i}$ and $(10{,}000)^{\Delta i}$ when the spin changes by Δi during the radioactive transformation, it is necessary to assign a spin of only 2 to 3 units to the nucleus of the hypothetical isotope in order to increase its half-value period to a reasonable figure

In conclusion, it may be pointed out that Klemperer's views are supported by the fact that the isotope, ${}_{19}K^{42}$, the existence of which has been definitely established by Hevesy and Høffer Jensen[4], is also a misfit as regards the Sargent relations Here again, the existence of quite a small nuclear spin of this isotope would clear up the contradiction between β velocity and life-time

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April 26

[1] *Proc Roy Soc* **148** 638, 1935
[2] *Phys Z*, **35** 540 1934
[3] *Proc Roy Soc*, **139**, 659, 1932
[4] NATURE, **135**, 96, Jan 19 1935

Induced β-Radioactivity by α-Particle Bombardment

LORD RUTHERFORD'S classical experiments showed that the emission of protons from the nuclei of the light elements, when these were bombarded with α-particles, was a fairly general phenomenon No protons, however, were observed from helium, lithium, beryllium, carbon or oxygen These results are significant, and suggest that ${}_2He^4$, ${}_6C^{12}$ and ${}_8O^{16}$ are very stable structures, probably consisting of close combinations of α particles The great stability of these isotopes is confirmed by Aston's work and by their behaviour under bombardment by high-speed ions. But both lithium and beryllium are disruptible by α-particles with the emission of neutrons, and while the structure $2\alpha + n$ for ${}_4\text{Be}^9$ will explain why no protons are emitted from this isotope under α-particle bombardment, it is difficult to see why no proton emission has been observed from lithium when bombarded with α-particles

In addition, it has been found that all elements which emit protons under α particle bombardment also emit neutrons, and, moreover, that many nuclei emit both protons and neutrons It is significant that neutron emission followed by positron radioactivity has been observed by Miss Meitner[1] when lithium is bombarded by α-particles, and this suggests that proton emission from this element should also be observed The reaction detected by Miss Meitner is :-

$${}_3\text{Li}^6 + \alpha \rightarrow {}_5\text{B}^9 + n \uparrow, \quad {}_5\text{B}^9 \rightarrow {}_4\text{Be}^9 + \overset{+}{e} \uparrow,$$

and we should therefore expect to observe

$${}_3\text{Li}^6 + \alpha \rightarrow {}_4\text{Be}^9 + p \uparrow$$

In addition, the neutron and proton emission from boron, namely,

$${}_5\text{B}^{10} + \alpha \rightarrow {}_7\text{N}^{13} + n \uparrow, \quad {}_7\text{N}^{13} \rightarrow {}_6\text{C}^{13} + \overset{+}{e} \uparrow,$$

$${}_5\text{B}^{10} + \alpha \rightarrow {}_6\text{C}^{13} + p \uparrow \text{ and } {}_5\text{B}^{11} + \alpha \rightarrow {}_7\text{N}^{14} + n \uparrow,$$

as well as the emission of both protons and neutrons from ${}_7\text{N}^{14}$ and ${}_9\text{F}^{19}$, ${}_{11}\text{Na}^{23}$, ${}_{13}\text{Al}^{27}$ and ${}_{15}\text{P}^{31}$ suggest, therefore, that the following reactions from the structurally similar nuclei ${}_3\text{Li}^7$ and ${}_5\text{B}^{11}$ should be possible .

$${}_3\text{Li}^7 + \alpha \rightarrow {}_4\text{Be}^{10} + p \uparrow$$
$${}_3\text{Li}^7 + \alpha \rightarrow {}_5\text{B}^{10} + n \uparrow$$
$${}_5\text{B}^{11} + \alpha \rightarrow {}_6\text{C}^{14} + p \uparrow$$

It is significant that ${}_4\text{Be}^{10}$ and ${}_6\text{C}^{14}$ are β radioactive, so that these actions indicate that the delayed emission of 'negative' electrons should be observed from lithium and boron when these elements are bombarded by α particles of suitable energy The detection of such β radioactivity with lithium would be evidence in favour of proton emission from this element

In a similar way, the production of β radioactive isotopes by proton emission from isotopes such as ${}_8\text{O}^{17}$, ${}_{10}\text{Ne}^{21}$, etc , for example,

$${}_8\text{O}^{17} + \alpha \rightarrow {}_9\text{F}^{20} + p \uparrow, \quad {}_{10}\text{Ne}^{21} + \alpha \rightarrow {}_{11}\text{Na}^{24} + p \uparrow,$$

is possible The abundance of these isotopes is, however, too small for such reactions to be detected experimentally As, however, ${}_3\text{Li}^7$ and ${}_5\text{B}^{11}$ are the more abundant isotopes of lithium and boron, we anticipate that the induced β-radioactivity due to ${}_4\text{Be}^{10}$ and ${}_6\text{C}^{14}$ should be experimentally detectable

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March 15

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[1] Meitner, *Naturwiss.*, **22**, 420, 1934

A Completely Supraconducting Galvanometer

SINCE it was thought that interesting experiments might be performed if it were possible to measure quantitatively persistent currents in a supraconducting circuit much smaller than have so far been detected with a magnetometer, there has been constructed in this laboratory a completely supraconducting moving-coil galvanometer. The coil consists of 100 turns of fine lead wire, connected by leads of lead to the experimental circuit The coil is suspended in the liquid helium by a rigid wire connected above the cryostat to an ordinary galvanometer suspension and mirror. With this arrangement the suspension remains nearly at room temperature The coil is completely shielded from moderate external magnetic fields by placing it inside a supraconducting cylinder of sheet lead, and thus is subjected only to the controlling magnetic field from a pair of copper coils within the cylinder

Mathematical investigation of the characteristics of a resistanceless galvanometer showed that its behaviour would be interesting, apart from its possible applications Assuming that, when the external circuit is also supraconducting, the whole can be treated as a circuit having zero resistance and self-inductance L, it was found

(1) With a persistent current i_0, such that the deflection when there is resistance in the circuit would be $d_0 = K i_0$, the coil should oscillate, undamped except mechanically, about a point

$$d' = d_0 \left(1 + \frac{n^2 A^2 H^2}{kL}\right)^{-1}$$

where nAH is the flux linked with the moving coil in its control field, and k is the torsion constant of the suspension

(2) For a given current i_0 the deflection should be a maximum, $d' = \frac{1}{2} d_0$, when $H = \sqrt{kL}/nA$.

The galvanometer has been tested by connecting it to a supraconducting tin coil in which a persistent current could be induced by means of an external magnetic field As first constructed, the coil oscillated as expected, damped only by the small viscosity of the liquid helium, but proved to be unsteady When artificial oil damping was introduced, the practical behaviour of the instrument was entirely satisfactory The deflections were found to depend in the manner expected upon the control field H, and can be used to give quantitative measurements of the current The sensitivity of the present instrument at the optimum field is about 5×10^{-5} ampere per mm

This confirmation of the predicted behaviour shows definitely that true persistent currents throughout the circuit were induced, agreeing quantitatively with the law of induction, when the field was applied to the tin coil In view of recent experiments upon the effects of magnetic fields upon supraconductors, it is interesting to note that the same deflection is obtained whether the control field is altered before or after the tin portion of the circuit becomes supraconducting, or before or after the persistent current is induced

Some of the experiments in which an instrument of this kind may be of use are

(1) Further investigations of the thermoelectric effect between two supraconductors around their transition points

(2) An attempt to settle the still doubtful question of the Hall effect in a supraconductor.

(3) Experiments on the distribution of persistent currents

(4) Studies of persistent currents which may throw some light on the recently discovered anomalous magnetic behaviour of certain supraconducting alloys

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May 4

The Dyestuff Industry

WHILST in general agreement with the admirable article on "The Dyestuffs Industry and its Lessons", in NATURE of April 27, I cannot endorse your acceptance of Mr. C J T Cronshaw's argument that "the industry languished because the pioneer spirit and the creative instinct which brought it into being abandoned it too early" I hold that the breakdown was entirely on the side represented by Mr Cronshaw—the managerial and commercial side Often in the distant past have I discussed the problem from this point of view with Griess, Caro, Dewar, Witt, Meldola, Martius and others The commercial community is not likely to recognise this, simply because the scientific spirit is foreign to its nature

Mr Cronshaw attributes our downfall to the too early retirement of Perkin and others I fear he has not the necessary feeling for the conditions prevailing in Perkin's time History cannot be written at a distance from the events by those who have had no direct knowledge of the period considered and of the men concerned I have more than once discussed the situation, most recently in an article in the *Pharmaceutical Journal* (April 29, 1931)

Perkin's retirement meant nothing, except that he was beaten in the race His original discovery of the dyestuff Mauve was a pure fluke His great and real discovery was of himself- of his inborn, outstanding ability as a chemical engineer, to use the now fashionable term He built up the industry from nothing—in particular, he transferred chemistry from glass to iron On the other hand, he proved himself to be without imaginative power—the additions he made to the colour palette were negligible. His second advance with alizarin was inspired from Germany and was again due to his constructive ability He worked too much in secret and failed until too late to foresee the need of a fully organised system of prospecting the field In fact, he was himself too narrowly trained He worked all but alone The real advance in the industry came through E. C. Nicholson and Hofmann through their expansion of the Rosaniline industry In fact, the initial establishment of the dyestuff industry in England was the work of the triumvirate, Perkin, Nicholson and Hofmann Perkin only led off Long before Perkin retired, the fate of the industry was sealed, already in 1865, when Hofmann returned to Germany, outwearied by his attempts to create a school here I began to study chemistry under him just before he left. Great as was the work he did, sound and broad as were the foundations he laid in aniline, our commercial outlook was too narrow and unintelligent for us to utilise his services Our men of means and our manufacturers did not send their sons to him His work was largely done with German assistants.

When Hofmann left the country and Nicholson retired, Perkin was left pivotless ; the example they had set him was withdrawn. He made his wonderful spurt, on his second horse Alizarin, without any support from a field ; soon he was left scurrying alone across the course. Nicholson had retired because his partners would not move with the times When the firm acquired Perkin's business, it was only to prove itself unable to carry the burden On Playfair's advice, both Griess and Dewar were approached but offered pettifogging terms The firm took Meldola and later on Green but did not know how to use either with effect

Our downfall was just lack of business wit it was due to our complete failure to place ourselves upon a scientific footing Williams, Thomas and Dower missed our third opportunity—that which Otto N Witt gave them, of leading in the azo-dyestuff industry- long before Duisberg's advent Griess and Witt, properly used together, could have established the industry here well in advance of the Germans

We are not out of the wood to day Our industry is insufficiently organised on the technical side far too narrowly commercial in its outlook The Germans have succeeded, not through one man management but through the close association of technical and commercial interests The main result of our so-called rationalisation has been to eliminate technical ability and understanding to a more than dangerous extent We are to day, I believe, in most serious danger of again being beaten by German scientific organisation. We cannot think in high places the commercial mind still prevails and will not brook true technical leadership Something more than the mere association of a few academic professors with the industry is needed In fact, the signs are only too clear that we are no longer making the progress we should if indeed we are 'holding water'

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Mutation Rates in Man

THERE is at present no information concerning mutation rates in vertebrates But where a gene produces a very great unfitness from the Darwinian point of view, that is to say, greatly diminishes the mean number of offspring produced by its bearers, then it will tend to disappear if its numbers are not kept up by mutation The rate of disappearance is extremely slow for an autosomal recessive, very rapid for a dominant or a sex linked recessive

Epiloia, or tuberose sclerosis, is a condition in which tumours of the skin, brain and sometimes of the heart and kidney, are liable to be associated with epilepsy and mental deficiency The mortality rate is high in severe cases, and probably most affected individuals have no children Pedigrees of the condition show that it is an autosomal dominant In each generation, however, a proportion of cases, which we estimate at about 25 per cent, are sporadic and are presumably due to mutation The frequency of epiloia in south-eastern England appears to be of the order of 1 in 30,000 This implies a mutation rate of about 1 in 120,000 per generation

Hæmophilia is a sex-linked recessive condition It is so fatal that the marriage rate of hæmophilics is about a quarter of the normal, and their actual fertility doubtless still lower In other words, three quarters or more of the hæmophilic genes in males are wiped out in each generation, and must be replaced by mutation if the population is in equilibrium. A simple calculation shows that, if there were no mutation, the incidence of the disease would be decreasing at such a rate that 1,000 years ago the whole population of England would have been hæmophilic Several human pedigrees show that hæmophilia may arise by mutation The frequency of hæmophilia in London males certainly exceeds 1 in 100,000 at birth and may well exceed 1 in 30,000 A rough estimate of the mutation rate is 1 in 50,000 to 100,000 per X chromosome per generation

Several other sub lethal dominant conditions, such as neurofibromatosis, seem to have frequencies, and therefore mutation rates, of the same order The highest mutation rate known for any locus in *Drosophila* is about 1 in 300,000 for the white locus Thus if we take the generation, and not, of course, the year, as unit, man seems to be somewhat more mutable than *Drosophila* A full account of our investigations will be published elsewhere

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A New Virus Disease of Tomatoes

IN 1931 the first appearance in Europe of the tomato virus disease known as 'spotted wilt' was recorded by this virus station[1] Since that date, the disease has spread through the length and breadth of *Great Britain*, and its ability to attack ornamental plants of all kinds has made the virus one of the major problems of the horticulturist

In view of these facts, it may be worth while recording the recent appearance of an apparently new and equally serious virus disease of tomatoes The virus in question was isolated from some diseased tomato plants sent in for examination, and the symptoms it produced on the various experimental plants differed from any with which I am familiar On tomato the symptoms are briefly as follows The first signs of infection, developed on the fifth day following inoculation, were pronounced yellowing of the inoculated leaves together with the appearance of yellow or purple rings or circular necrotic spots Later, the youngest leaves showed a tendency to twist round and become pale yellow in colour The next development was the appearance of a gross lesion on the stem, at and just below soil level, this was followed by a general wilting and collapse of the plant (Fig 1). The stem lesion appeared to be more characteristic of infection of younger plants

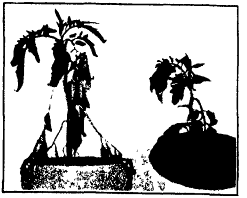

FIG 1 A new virus disease of tomatoes, the lesion in the stem at soil level (right hand plant) is characteristic

The virus causing this disease has been differentiated from all the known viruses affecting tomatoes in the British Isles by ultra-filtration and immunity studies, by its physical properties and particularly by its symptom expressions on differential hosts The unusual reaction of the virus upon cowpea, *Vigna sinensis* (Fig 2), is alone sufficient to differentiate it from the viruses of the tomato streak group

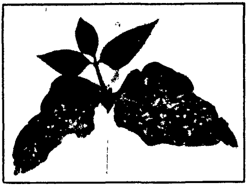

FIG 2 The tomato virus upon cowpea the virus is usually confined to the inoculated leaves

I wish to express my indebtedness to Mr Lawrence Ogilvie, of the Long Ashton Research Station, Bristol, who sent me the affected plants

KENNETH M SMITH.

Potato Virus Research Station,
School of Agriculture,
Cambridge
May 8

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[1] NATURE, **127**, 852, 1931

Pleistocene Coastal Deposits in Palestine

ANYONE who has travelled by train along the coast of Palestine from Haifa to Ludd cannot have failed to notice, soon after rounding the northern point of Carmel, a low ridge of sandstone running roughly parallel with the railway line and the sea It begins 5 km to the south of Cape Carmel, and continues for approximately 32 km

The Crusader's Castle at Athlit was built with stone taken from this ridge, and more recently, in 1930, two big quarries were opened in it to the north of Athlit Station to supply the stone for the great breakwater of Haifa harbour

The rock of which the coastal ridge is formed has generally been regarded by geologists as a marine formation of Pliocene age, and had not attracted the attention of prehistorians In the course of a short visit to Athlit in April of this year we decided to devote some time to this problem, and two days were spent in a close examination of the area In the quarry sections, which have an average height of about 13 m and are more than half a kilometre in length, the following observations were made .

(1) The ridge is mainly composed of wind-blown sand showing typical æolian current bedding, and containing comminuted shells.

(2) A conspicuous layer of red earth varying in thickness from a few centimetres to 1 m divides the sandstone into two approximately equal series.

(3) In this layer a considerable number of flint implements were found at various points.

(4) Land shells occur in both the upper and lower sandstones and in the red earth

It was at once evident that the flints were not of any considerable age—certainly not Pliocene The most interesting specimens found *in situ* were a side-scraper of Mousterian type and two small Levallois cores The remainder were mere chips and small flakes Among those found adhering to fallen blocks, or on the quarry floor, were three good Levallois flakes, a rough circular scraper, and a Levallois core , the remainder were small flakes and chips So far as can be judged from the material at our disposal, the industry closely resembles the Upper Mousterian found in the caves of the Wady Mughara (Mugharet-El-Wad, Layer G , Et Tabūn, Layer B)

It seems safe to conclude that the bulk of the ridge is relatively late Pleistocene in age, and that it is essentially æolian in origin

These discoveries raise more than local problems in Palestinian geology and prehistory, and we propose early next year to make a detailed investigation, not only of this ridge, but also of the coastal deposits southwards

D A E GARROD
E. W. GARDNER

Cambridge

Dielectric Polarisation of Phenol

IT is well known that the molecular polarisation of alcohols in a non polar medium is exceptional in that it at first increases with concentration and then falls finally to a lower value than that at which it started The data of Williams and Allgeier[1] show that at 25° up to a molar fraction of 0·345 the polarisation of phenol in benzene is constant, whilst those of Donle and Gehrckens[2] show a decrease in polarisation at 22° up to a concentration of 0 05 molar fraction phenol and those of Philip and Haynes[3] an increase at 20° in dilute solutions I have measured the polarisation of phenol in benzene at 70° with the following results ·

c_2	ε	d	P_2
0 10737	2 540	0 84750	73 43
0 13464	2 639	0 85340	73·56
0 20170	2 934	0 86808	75 35
0 20330	2 943	0 86804	75 55
0 32460	3 567	0 89425	76 20
0 40717	4 063	0 91188	75 85
0 45454	4 375	0 92147	75 52
0 59956	5 458	0 95200	73 79
0 72570	6 517	0 97812	69 78
1 00000	9 161	1 0307	66 72

c_2 is the molar fraction of phenol, ε is the dielectric constant, d is the density, and P_2 is molecular polarisation of phenol The molecular polarisation of benzene at this temperature is 26 928

The behaviour of phenol at this temperature appears to be similar to that of the lower alcohols, which would be expected from its hydroxylic nature

These results give a value of ∞P_2 of 71 0, which, if we take $P_E + P_A$ to be 31·0[4], gives 1·5 debyes for the dipole moment, compared with the values 1 55 of Donle and Gehrckens and 1·70 of Williams

A. R MARTIN

Chemistry Department,
University of Aberdeen
March 18.

Catalysis of Ester Hydrolysis by D_3O^+ Ions

IT has been observed by Moelwyn-Hughes[1] that the catalytic influence of D_3O^+ ions on the inversion of cane sugar in heavy water is greater than that produced by H_3O^+ ions in ordinary water, and Schwarz[2] observed that the acid hydrolysis of methyl and ethyl acetates takes place about 50 per cent more quickly in heavy than in light water under similar conditions

The rate of hydrolysis of methyl acetate in sulphuric acid solutions has been determined by means of a viscosity method by which the whole reaction can be followed with less than 1 c c of solution, and it is found that the ratios of the catalytic coefficients in heavy and light water (taking the sulphuric acid as completely dissociated in both cases) are $k_{D_3O^+}/k_{H_3O^+} = 1$ 86 at 15° and 1·68 at 25° These ratios are nearly the same as those found by Moelwyn-Hughes for the inversion of cane sugar

J C HORNEL

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West Mains Road,
Edinburgh
March 27

Esterification of Phosphate in the Respiratory Breakdown of Sugar in Higher Plants

HARDEN and Young[1] showed that phosphate undergoes an important cycle of changes in the fermentation of sugar by yeast juice, being first converted into a hexosephosphoric ester and finally liberated as inorganic phosphate when all the sugar was fermented Recently, Meyerhof[2] showed an identical condition in the production of lactic acid from hexose in muscle extracts The view has therefore been expressed that esterification with phosphoric acid may be a necessary step in the biological degradation of sugar In the higher plants, however, there has been no direct proof of esterification in respiratory sugar metabolism, though a close parallel between alcoholic fermentation and anærobic respiration has been assumed from the first and has been confirmed not only by the discovery of identical enzymes in both, but also by the fact that phosphate stimulates plant respiration Phosphate has also been shown to disappear when added to ground peas[3] , and phosphoric esters have even been isolated from plants[4]

I have obtained definite results on this phase of sugar breakdown in higher plants by devising a method of preparing cell free glycolytic aqueous extracts (stable for a few hours) by plasmolysing fermenting peas (*Pisum sativum*) The fresh extract, presumably containing the full zymase-complex in solution, actively ferments glucose, fructose or sucrose with evolution of carbon dioxide, under strictly aseptic conditions In order to follow esterification and sugar breakdown, 40 c.c of the fresh extract at *p*H 6·2, after nitrogen had been bubbled through, was incubated with glucose, in presence of toluene, at 30° C A suitable quantity of a phosphate buffer was added and samples withdrawn after every 5–15 minutes of mechanical shaking The value of inorganic phosphate in the trichloracetic acid filtrate of the samples, as determined by the Fiske and Subbarow method, was found to fall rapidly and steadily and rise again in 30–60 minutes nearly to, but sometimes above, the original level, while glucose (Folin's blood sugar method) showed a fall at the beginning, then a rise and next a rapid and steady fall from a point where all the esterified phosphate was beginning to be liberated This result has been repeatedly and consistently obtained with extracts from several varieties of peas, not from ground peas alone When efforts were made to measure the carbon dioxide output in response to phosphate in a differential manometer, the large amount of colloidal protein present as impurity in the extract interfered by holding large quantities of the gas

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[1] *J. Amer Chem Soc*, **49**, 2416 , 1927
[2] *Z. Phys Chem*, B, **18**, 316 , 1932
[3] *J. Chem. Soc*, **87**, 998; 1905
[4] Donle and Gehrckens, *loc. cit*

[1] *Z phys Chem*, B, **26**, 272 , 1934
[2] *Akad Anz Wien*, April 1934

This demonstration of phosphate esterification brings the higher plant (pea) fully in line with yeast and animal muscle in this respect But it is to be expected that when the new problems confronted in these cell free extracts are fully investigated, the course of respiratory sugar breakdown in higher plants may have its own individual peculiarities, as in fact further new results I have obtained seem to hint Detailed results, and the method of preparing the extracts, are to be published shortly elsewhere

M SADASHIVA RAO.

Plant Physiological Laboratory,
Institute of Agricultural Research,
Benares Hindu University
March 18

[1] *Proc Chem Soc*, **21**, 189, 1905, and onwards
[2] *Biochem Z*, **183**, 176, 1927
[3] *Biochem Z*, **165**, 1, 1925
[4] *Biochem Z*, **219**, 364, 1930

Application of Microchemical Tests in Assessing the Quality of Ash Timber

DURING the last few years, attention has been given in this laboratory to the study of the anatomical structure of ash timber in relation to the maximum crushing strength in compression parallel to grain Consignments of trees from seven localities have been studied, and each site had a distinctive strength specific gravity regression Variations in the amount of wood substance per unit volume, therefore, do not account completely for variations in strength, and it has been shown that the arrangement of the wood substance in the annual ring also influences the mechanical properties[1] The fact, however, that specimens of equal specific gravity and closely similar anatomical structure sometimes differ by more than 30 per cent in maximum crushing strength suggests that still other factors are involved and that probably the physical and/or chemical nature of the wood substance is of great importance in determining strength

Several methods of examination were tried in comparing pairs of specimens of strong and weak types of timber, the individuals of each pair being matched in respect of specific gravity and gross anatomical features, but differing considerably in strength It was discovered that a phloroglucin-hydrochloric acid solution could be used to distinguish between the members of each pair In strong specimens, the whole of the fibre-walls stained red, and in the weakest type the middle lamella region stained a faint pink, the secondary walls remaining unstained All intermediate types of staining were observed

So far, the method has been applied with success to timber tested in compression parallel to the grain It has also indicated excessive weakness in a number of defective hockey sticks, and it is intended in the immediate future to investigate the toughness of ash by the same method

With regard to the nature of the chemical reactions involved, it is not at present possible to do more than direct attention to the fact that of the so-called standard lignin reagents, phloroglucin-hydrochloric acid is apparently the only one capable of differentiating between strong and abnormally weak types of timber

S. H. CLARKE

Forest Products Research Laboratory,
Princes Risborough
April 10.

[1] Clarke, S H, *Forestry*, **7**, 26, 1933

The Classification of Coals

FROM a chemical point of view may I dissent from much that is said about the Stopes nomenclature for the visible ingredients of bituminous coals in Dr Lessing's article in NATURE of April 27

In the first place, there seems to me to be nothing particularly new or advantageous in it Every observant person knows that bituminous coal is usually composed of bright and dull layers, and for a century or more these have been distinguished as the 'bright coal' ('Glanzkohle') and 'dull coal' ('Mattkohle') respectively It has also been long known that between such layers there is an amorphous powdery substance that blackens the hands, and commonly called 'mineral charcoal', or by miners the 'dant' I have never been able to see any sufficient reason for substituting such terms (imported from France) as 'vitrain' and 'clarain' for the 'bright coal', 'durain' for the 'dull coal' and 'fusain' for the 'mineral charcoal' or 'dant', unless indeed for consistency 'charbon' be also substituted for 'coal' in naming the main substance Inasmuch as such substitutions have tended to mystify people, and to make believe that somehow or other coal is better explained thereby, I deprecate the further elaboration of them referred to in Dr. Lessing's article

Secondly, I think the article misleading in saying that "the subdivision of coal into the four visible Stopes ingredients has been widely accepted in Great Britain and in most European countries" without indicating that, outside the exclusive circle of the 'Coal Research Club', it has been much criticised and by no means generally adopted

Throughout the systematic researches into the chemical constitution of coals and their maturing which for years past have been carried out in my laboratories here, and which have comprised coals from all parts of the world and representative of all stages in the peat → brown coal → lignite → bituminous coal → anthracite series, the Stopes nomenclature has been of little assistance, and I venture to think it has no chemical significance. Our experience does not support Dr Lessing's statement that its four isolated components are "different and typical in their chemical composition . . . associated with mineral matter in characteristic amount and composition . . [and] contain groups of organic compounds and plant residues in defined ratios". Moreover, although it has been repeatedly suggested that the coking propensities of bituminous coal reside in the 'vitrain', we here disbelieve it.

It seems to me that a scientific classification should not only be applicable to all types of coals but also have a more fundamental basis than any yet proposed.

WILLIAM A. BONE.

Imperial College of Science
and Technology,
London, S.W.7.
April 29.

AN adequate and reasoned reply to Prof. Bone's letter would require more space than, as I am given to understand, NATURE can afford. I must, therefore, let the statements in my article, which I endeavoured to make in a critical and impartial spirit, speak for themselves.

I may, however, be permitted to refer to two points raised in Prof. Bone's letter. A perusal of the literature on the formation and the chemical and petrographic constitution of coal and its commercial preparation and utilisation during the last ten years provides evidence of the wide use of the terms proposed by Stopes and of the acceptance of what they are intended to signify. I tried to make it clear in my article that only qualified acceptance has been accorded to them in some quarters.

Prof. Bone's experience that the isolated coal components are not different and typical in their chemical composition is contrary to the results of hundreds of analyses and carbonising tests published by workers in Great Britain and many other countries. My own work on the behaviour of the coal components during carbonisation, and on the composition and distribution of the mineral matter in coal, furnishes ample proof for the statement made in my article. However, by its very nature the composite character of coal does not permit of ready generalisation, and if Prof. Bone is aware of cases in which typical differences in composition between coal components or their ashes cannot be recognised, he would earn the thanks of other workers interested in the subject for bringing these exceptions to their notice.

R. LESSING.

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Westminster, S.W.1.

Philosophy and Modern Science

WHEN I read Dr. H. Dingle's book "Science and Human Experience" I found that I agreed with nearly all of it; now I find myself in disagreement with most of his article in the Jubilee issue of NATURE. I realise that he may not be expressing his own views, but be trying to summarise those of others, and that most of those he expresses are prevalent; but I cannot convince myself that they are right. The differences begin with what he calls the fundamental principle of the rejection of unobservables. No distinction is made between sensations and concepts. Dr. Dingle makes general observability part of his criterion; since each sensation is private to one individual, he thereby leaves the whole basis of our experience out of science. The principle cannot be applied to concepts, because in fact they are not observed by anybody. If we are realists we may say that they are inferred; if we are phenomenalists we may say that they are constructed. If there is any change in scientific thought in this respect, it is that our realists have now a greater disposition to modify their ideas of *what* is real when new data derived from sensation become available.

The scientific validity of a concept in fact depends on quite different criteria; it depends on whether the concept and the postulated laws that it satisfies help to co-ordinate our sensations. If different people find the same concepts useful, that is because to a considerable extent they have similar sensations and similar processes of thought; but what are sensations to one are concepts to another. The rejection of unnecessary concepts is not a fundamental principle at all; it is a practical rule of method, like not putting six pairs of knives and forks on the table for a two course dinner. Thus I cannot agree that the rejection of absolute position was the great feature of the principle of relativity; the important thing was the statement of the laws satisfied by relative position. Admittedly the method made the detection of the law easier; that is why it was a good method. But the important thing was the application of the principle that a formally simple law has an appreciable *a priori* probability. I have shown in my "Scientific Inference" that this principle is fundamental, and that without it we could never attach a high probability to any quantitative law however often it is verified; but though it is universally used, people seem to have a curious reluctance to admit that they are using it. Let us respect the broom; but there is no need to be ashamed of the electric light.

The confusion between sensations and concepts again vitiates Dr. Dingle's answer to the question 'Do things exist when they are not observed?' Sensations obviously do not; but would Dr. Dingle return the answer 'No' to the question, 'Did Neptune exist before it was observed?' The fact is that when we say we observe a thing we do nothing of the sort; we have certain sensations and we assert the result of a long chain of inference from them, which is not the shorter because we have made inferences of the same type so often that we carry them out rapidly and often forget that they are there. The perturbations of Uranus afforded just the same kind of ground epistemologically for inferring the existence of Neptune that a telescopic observation does.

The 'principle of causality', again, has no scientific status. As has been repeatedly pointed out, nobody has ever succeeded in stating it in such a way that it will help us to say *what* laws are causal. We know of many actual causal laws, and there is reason to believe that many others remain to be discovered; but the notion of a universal principle of causality is by nature incapable of verification and in practice useless. What is used in practice, consciously or not, is the simplicity postulate.

I am mystified by Dr. Dingle's statement that a probability is the ratio of two integers. Given that a point is equally likely to be anywhere within a length a, what is the probability that it lies within distance $a/\sqrt{2}$ of one end? Or does he contemplate a field such that all distances between possible positions are integral multiples of some universal length, so that continuous variation is excluded?

HAROLD JEFFREYS.

St. John's College,
Cambridge.

THE necessity for condensed expression is, I think, responsible for the questions raised by Dr Jeffreys I admit (indeed, insist on) the distinction between sensations and concepts, but left it unstated because I thought it was implied in the language used The principle of rejection of unobservables must refer only to concepts, we cannot speak of observing sensations because a sensation is an observation, not a thing to be observed I cannot reject a sensation of whiteness which may come to me, but I can reject the concept, ghost I do not share Dr Jeffreys's objection to the phrase, "observing a concept" (for example, observing Neptune) It is unambiguous and far more concise than any alternative which his letter suggests

I agree completely (though I should express it differently) with Dr Jeffreys's paragraph containing the question, "Did Neptune exist before it was observed?" If that question has a meaning, the answer is the ordinary commonsense one—yes, for Neptune is conceived as an object existing in space and time This answer, however, contradicts the principle of rejection of unobservables, so we must ultimately (for scientific purposes of course, not for practical life) give up the concept, and then the question becomes meaningless It is the task of science to discover the significant substitutes Twenty years ago the question was asked Does an electron exist during a transition between two Bohr orbits? We do not now answer yes or no, but abandon the concept of a spatio temporal electron moving from orbit to orbit

Dr Jeffreys's probability problem, as he says, involves continuous variation and therefore is irrelevant Science aims at the correlation of observations which are discrete Hence, unless we wish to correlate unobservables at the same time, the only kind of probability which is applicable is that involving integers, for example, statistical probabilities such as the familiar ones deduced from experiments on throwing dice

The difficulties of mutual understanding in these matters are illustrated in an amusing way by the letters of Dr Jeffreys and Prof Levy The former admits that the views I expressed are prevalent but thinks they may not be mine The latter regards them as not only not prevalent, but also essentially my own private analysis!

HERBERT DINGLE

Imperial College of Science,
London, S W 7
May 8

Existence of Three Alum Structures

THE crystals which comprise the alum series have generally been considered to be isomorphous on account of the similarity of their chemical formulæ and of their crystal classes The more direct evidence of X-ray diffraction shows, however, that there are at least three different structures involved It is proposed to call these the α, β and γ structures, in order of their discovery

The α structure is that of potassium alum[1], and of the other common alums which have been examined The β-structure is that of methyl-ammonium alum[2] and of cæsium alum, though the α structure can be induced in the former by deposition on rubidium alum Sodium alum is the sole example so far found of the γ-structure

The presence of the form {210} on crystals grown from neutral aqueous solution seems to be characteristic of the β-structure This property provides an easy way of separating cæsium and rubidium alums, for crystals grown from a solution of the two can be distinguished by eye

The non isomorphism of the alums raises doubts concerning other series of salts Nevertheless, it is probable that only in the cubic system can such pseudo-isomorphism exist, for the high symmetry is due to that of the component groups, and may be maintained with different arrangement of these groups In the other crystal systems it is improbable that the axial ratios and inter axial angles of a number of crystals of similar chemical constitution would be almost equal unless the crystals were truly isomorphous

An account of the structure of sodium alum and an examination of the relationship between the α, β and γ structures will be published elsewhere

H LIPSON

George Holt Physics Laboratory,
University Liverpool March 13

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[1] Lipson and Beevers, *Proc Roy Soc*, A **148**, 664, 1935

[2] Lipson, *Phil Mag* (in the press)

Conductivity of Oils and Waxes

A FEW years ago I detected a curious region of negative temperature coefficient of the conductivity of heavy oils, namely, a rising conductivity with decreasing temperature[1] It occurred in the neighbourhood of the solidifying point A similar phenomenon has recently been observed by W Jackson with paraffin wax[2], just below its melting point The effect is thought to represent probably a characteristic of both oils and waxes, at least of those containing hydrocarbons It seems therefore desirable to put forward a theory to account for it

A transition between the glassy and the crystalline phase in a mixture like oil must extend over a certain range of temperature The conductivity of the oil in this range is therefore that of a two-phase system The experimental curves suggest that the extrapolated conductivity of the glassy phase in the transition region is lower than that of the crystalline phase Consequently the region of negative temperature coefficient may easily be explained by progressive crystallisation with decreasing temperature This theory also accounts for the dielectric absorption which is always very pronounced in the melting region

Assuming the theory to be correct, it is possible to calculate from experimental conductivity curves, obtained with special oils and waxes, the melting curve, the latter yielding the relative amounts of components of given 'melting point' This curve permits certain conclusions to be drawn as to the approximate chemical composition of the oil, provided its basic nature is known

This work has been carried out for the British Electrical and Allied Industries Research Association, and will probably be published in detail in due course

A GEMANT

Engineering Laboratory,
University, Oxford
March 9.

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[1] *Z Phys*, 75, 613 1932

[2] NATURE, **133**, 647, 1934

Raman Spectrum of Trideuter-Acetic Deuteracid

AN account of the preparation of trideuteracetic deuteracid (CD_3CO_2D) by one of us (C. L. W.) will appear shortly in the *Journal of the Chemical Society*. Its Raman spectrum has been examined and gives preliminary results of great interest. The spectrum was obtained from 1·5 c.c. of the substance exposed for 23½ hours to excitation from a mercury arc filtered to transmit only the 4358 A. line.

Displacement	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
CH_3CO_2H	447	621	895	1360	1430	1666	2942	3022
CD_3CO_2D	411	580	800	1025	1093	1657	2150	2218

In the accompanying table, the Raman displacements observed are compared with definitely established displacements for acetic acid. All the displacements of CH_3CO_2H, except *f*, are modified to lower wave number values, but since this frequency is attributable to an inner vibration of the CO_2H group, no change in its value is to be expected. The displacements *g* and *h* most probably have their origin in the C-H link, and preliminary calculations of the expected modification give results in good agreement with the observed values. It is possible that one of these displacements arises from an O-H link, but definite proof of this will be obtained, we hope, by an examination of the spectrum of acetic deuteracid (CH_3CO_2D). The examination of CH_3CO_2D will also give valuable information regarding the other displacements. At present, the origin of these is a little uncertain. Most probably *a* and *b* are associated with bonding frequencies of a C-C or C-O link; from intensity considerations, *c* almost certainly belongs to the C-C link, whilst *d* and *e* may arise from the CH_3 or CO_2H groups, and it is hoped this will be decided by the proposed investigation of CH_3CO_2D.

Work is proceeding on CH_3CO_2H prepared by the same method and measured by the same technique, partly to obtain comparable experimental data and partly to clear up certain points on which there is not complete concordance in the results of previous investigators.

The complete results for the three acids and a discussion of the origin of the frequencies will be published elsewhere as soon as the investigation is finished.

W. BOGIE ANGUS.
A. H. LECKIE.
C. L. WILSON.

Sir William Ramsay Laboratories of
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University College,
London, W.C.1.
March 18.

Infra-Red Absorption Spectrum of Crystalline Sodium Nitrite

THERE are very few data available in the infra-red absorption spectra of solids which enable an application of the modern ideas of point group symmetry to the classification of 'proper' vibrations. We have recently examined the absorption spectrum of sodium nitrite in the solid state. The substance has already been shown to be orthorhombic, and thus biaxial, with considerable separation between the indices of refraction. There are two molecules in the unit cell, and there will be eight particles in the basic group; accordingly we shall expect 3(8 − 1) = 21 'proper' vibrations, of which six will be 'inner' vibrations, and fifteen 'external' or lattice vibrations. Generally, some of the inner vibrations will coincide in pairs, but if the nitrite group is angular, its symmetry will be C_{2v}, which is the same as that of the crystal group[1], and we may expect considerable separation between the pairs. These conditions do not occur in the free ion, and A. Langseth and E. Walles[2] have obtained a clear and satisfying Raman spectrum for the aqueous solution with $\nu_1 = 1331$, $\nu_3 = 1240$, $\nu_2 = 813$ cm.$^{-1}$. In our case all the fundamental frequencies and overtones are doubled, bands occurring at $\nu_2 = 707$ and 834 (10), $\nu_3 = 1127$, 1220 (14), $\nu_1 = 1330$ and 1392 (10), $2\nu_2 = 1378$, 1626 (4), $2\nu_3 = 2252$, 2439 (2), $2\nu_1 = 2646$, 2762 (3). The numbers in brackets give an approximate measure of the relative intensities. The bands at 707 cm.$^{-1}$ and 834 cm.$^{-1}$ have faint wings on each side, which may perhaps be explained by the trichroism of the substance.

Dr. W. R. Angus and Mr. A. H. Leckie of this Department have kindly examined the Raman spectrum of the solid. They find a broad band in the region of 1350 cm.$^{-1}$ with a strong sharp maximum at 1314 cm.$^{-1}$, a weak indication at 1352 cm.$^{-1}$, and a weak but sharp peak at 1400 cm.$^{-1}$. We are continuing the infra-red analysis with polarised light.

Ziegler suggested a vertical angle of some 132°, but our results are in agreement with those of Langseth and Walles, since the frequencies satisfy a central force system with an angle of 96°. There seems to be a single bond between the nitrogen and each oxygen atom, whereas the binding in the nitro-group is of the same type as in SO_2, corresponding to a vertical angle of some 120°.

C. R. BAILEY.
J. W. THOMPSON.

Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College, London, W.C.1.
March 20.

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[1] G. E. Ziegler, *Phys. Rev.*, **38**, 1040; 1931.
[2] *Z. phys. Chem.*, B, **27**, 209; 1934.

A New Emission Spectrum in Selenium Vapour

IN the course of a systematic study of the excitation of selenium vapour in a high frequency discharge, we have observed, on the short wave side of the main $^1\Sigma-^1\Sigma$ system[1], a new system of about forty weak and diffuse bands degraded to the red which may be approximately represented by the following formula:

$$\nu = 29{,}890 + 285\,n' - 3\,n'^2 - 390\,n''.$$

These bands appear at low temperatures, before the main system becomes visible; but when the temperature is raised, the main system becomes incomparably more intensified than the new one.

The similarity of the vibrational structure of the new system to the main one[2],

$$\nu = 25{,}905 + 281{\cdot}3\,n' - 2{\cdot}42\,n'^2 - 387{\cdot}2\,n'' + 0{\cdot}63\,n''^2,$$

together with the conditions of the excitation and their appearance (large structureless bands) make it plausible that the new system is to be attributed to the excitation of the Se_2 group in a polyatomic molecule of selenium. This seems to be confirmed by the fact that a set of absorption bands observed by Moraczewska[3] in selenium, at a temperature at which its vapour is certainly polyatomic, represents the continuation of our $n''=0$ sequence A further study of this system promises interesting conclusions as to the binding energy and structure of such polyatomic molecules, of which little is known

A full account of our investigations will be published in the *Bull Acad roy Belgique*

B ROSEN
M DÉSIRANT

Department of Astrophysics,
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[1] B Rosen, *Z Phys*, **43**, 100, 1927
[2] E Olsson, *Z Phys*, **90** 138, 1934
[3] M Moraczewska, *Z Phys*, **62**, 275 1930

Suggested Polarisation of Electrons

G P THOMSON[1] has investigated the peculiar form of asymmetry in the scattering of electrons reported by Rupp[2] According to Rupp, fast electrons when scattered first by gold through 90° and then passed *through a gold foil show asymmetrical diffraction* rings, while Thomson could not find any asymmetry up to the voltage of 160 k v

We have repeated these experiments, extending the voltage up to 190 k v, but no effect was found As in Rupp's experiments, a thick target was used for the first scatterer Special precautions were made to prevent the non uniformity of backgrounds, photometric as well as visual comparisons were made on rings up to $\sqrt{35}$ and $\sqrt{36}$ Eight plates were obtained at voltage ranging from 150 to 190 k v, but none of them showed any asymmetry such as reported by Rupp

MITIO HATOYAMA
MOTOHARU KIMURA

Institute of Physical and Chemical Research,
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March 2

[1] Thomson, NATURE, **132**, 1006, 1933 *Phil Mag*, **17**, 1058, 1934
[2] Rupp, *Phys Z*, **33**, 158, 937, 1932

Magnetron Oscillations

IN recent issues of NATURE[1], a discussion took place between us regarding the short wave oscillations produced by split-anode magnetron valves After further discussion in private correspondence, we are now agreed on the following points

(1) The oscillations observed by Posthumus[2] in 2- and 4-anode magnetron circuits with wave lengths of the order of 1 metre appear, on the experimental evidence, to be of the same type as those previously observed by Megaw[3] and others in 2 anode magnetron circuits with similar wave-lengths The original difference of opinion on this point arose through the emphasis laid on the static negative resistance characteristics in Megaw's explanation of these oscillations

(2) Static negative resistance characteristics ('dynatron' characteristics) can be observed in both 2- and 4-anode magnetrons under suitable experimental conditions With usual valve dimensions, these characteristics enable oscillations to be maintained only in circuits of rather low decrement

(3) At very short wave-lengths, the effect of electron inertia on the dynamic characteristics is such that the term 'dynatron' applied to these oscillations by Megaw is probably a misnomer At such wave-lengths the maintenance of oscillations appears to depend on the final energies of the electrons, which may be less than the energy corresponding to the anode voltage, rather than on the angles traversed by the electrons during their transit, which determine the static 'dynatron' characteristics This conclusion follows from the success of the 'rotating field theory' of Posthumus[4] in predicting the relation between optimum wave-length range, anode voltage and magnetic field strength

(4) It appears from recent experiments carried out by Megaw that there is no discontinuity between the short wave oscillations under discussion and the longer wave oscillations, which are adequately explained by the negative resistance characteristics, when the decrement of the oscillatory circuit is sufficiently low With circuits of higher decrement, discontinuities may be observed due to the decrease in valve impedance which may occur when the oscillation period is comparable with the electron transit time, particularly when higher modes of oscillation of the circuit are readily excited

IR K POSTHUMUS

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E C S MEGAW

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Wembley.
March 1

[1] NATURE, **134**, 324, 1934 **134**, 699, 1934
[2] NATURE, **134**, 179, 1934
[3] *J Inst Elec Eng*, **72**, 326, 1933
[4] *Wireless Eng*, **12**, 126, 1935

Dew Ponds

THE legend that dew has anything particular to do with 'dew ponds' seems to die very hard. The essence of a dew pond surely is that it should be watertight, which those who make them seem to know quite well Except in very abnormal years such as 1921 (and I suppose 1933 and perhaps 1934, though I have not seen the figures) the rainfall in England for the year largely exceeds the loss by evaporation from a water surface, and in an average year an empty watertight pond will have accumulated about 5 inches of water from January 1 to the end of April, will lose 2 inches during the next three months and will then progressively become deeper until at the end of the year it has 11 inches Evaporation averages about 15 inches and never exceeds 20 inches, so that making allowance for the probability that it is a good deal more in exposed ponds than in the relatively sheltered tanks in which it is measured, it would seem that 2 feet of water in the early spring would see any watertight pond safely through any summer It is also desirable that there should be no standing vegetation, which downland farmers know, though they attribute its bad effect to the roots perforating the floor of the pond rather than to transpiration, which is extraordinarily effective Last summer (1934) a cement tank in my garden with *Potamogeton crispus* and *Lemna* lost 5 inches of water, while a precisely similar tank a few feet away which had three good clumps of *Alisma plantago* lost 19 inches and went dry.

A. E. BOYCOTT

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May 15.

Mechanism of Feeding in Blood-sucking Diptera

IN a previous communication[1] I reported the discovery of a sucking stylet in ticks which, to all appearances, was the homologue of the hypopharynx in other blood-sucking arthropods On the analogy of the feeding mechanism in ticks, it seemed reasonable to postulate that in biting flies the food channel is not formed by the apposition of the labrum epipharynx and the hypopharynx, as has hitherto been supposed, but that it is represented exclusively by what has until now been regarded as the hypopharyngeal extension of the salivary duct I referred to this tentative conclusion at the meeting of the Royal Entomological Society of London held on October 3, 1934[2] I have now carried out numerous dissections upon freshly killed specimens of *Stomoxys calcitrans*. As will appear from Figs 1 and 2, the labrum-epipharynx in this species of fly is entirely unconnected with the buccal chamber and is practically separated from the hypopharynx by an inward thrust of the apodeme, whilst the buccal chamber itself is continued directly into the expanded proximal portion of the hypopharynx, with the salivary duct terminating distally at this point

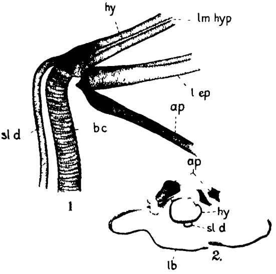

FIG. 1 Buccal chamber and the proximal portion of the mouth parts of *Stomoxys calcitrans* (the labium is not shown) Side view *ap*, apodeme, *b c*, buccal chamber, *hy*, hypopharynx, *l ep*, labrum-epipharynx, *lm hyp*, lumen of hypopharynx, *sl d*, salivary duct × 90

FIG. 2. Transverse section through the mouth-parts of *S calcitrans* at level of articulation of the apodemes *ap*, apodemes, *hy*, hypopharynx, *lb*, labium, *sl.d*, salivary duct × 110

Furthermore, in fresh specimens the hypopharynx is seen to be provided with a distinct orifice at its distal extremity, and its tubular character is shown by the fact that, when the flies are fed on a suitable colouring substance (for example, hæmatoxylin) that has previously been sweetened with sugar, the hypopharynx takes the stain along the entire length of the walls of its lumen, while its external surface retains its normal colour.

S. K. SEN.

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April 11.

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[1] NATURE, 134, 644, 1934
[2] *Proc. Roy. Ent Soc*, 9, 76, 1934

Trichromic Vision

THE trichromics, that is those who see three colours in a bright spectrum, red, green and violet, are confused by many with the anomalous trichromatics, whereas they are quite distinct The anomalous trichromatics, as defined by the late Lord Rayleigh, make an anomalous equation and do not agree with the normal equation, and they may not be colour-blind. The trichromics are invariably dangerously colour-blind, and though they may make an anomalous equation they may also agree with the normal equation

The following case will make this clear Examined with Ishihara, read all the figures with the ease and rapidity of a normal sighted person Examined with lantern, called red, white, white, red, green, red, and green, white Tested by colour equations, 10 red, λ633 + 10 green λ540, being the normal equation, matching the light of the arc Made equations ranging from 10 red + 33 green to 10 red + 5 green He also made the normal equation The luminosity in each case was correct Saw three colours in the spectrum red, green, and violet, described λ585 as red mottled, saw green at λ574, named isolated division λ553 5 – λ598 as all green

It will be seen that this case appears both as a high grade red anomaly, a high grade green anomaly and he also made the normal equation It will be noticed that the trichromic in conditions of difficulty, as for example with small lights, make dichromic mistakes

F W EDRIDGE-GREEN.

Board of Trade,
London, S W 1
May 3

Vitamin and Nitrogenous Food Requirements of the True Lactic Acid Bacteria

IT has now been successfully shown in this laboratory that all the lactic acid bacteria, *Streptococci* as well as rod-shaped forms, demand an alkali stable substance, related to bios, for their growth The rod forms require, in addition to this substance, lactoflavin and possibly still another activator

Earlier research seems to indicate that the true lactic acid bacteria are very fastidious in their requirements as to nitrogenous food Without knowledge of the facts mentioned above, it has been impossible to study this question because the lactic acid bacteria do not grow in a complete mixture of the amino acids present in genuine proteins when activators are absent It has now been found that the *Thermobacteria* show just as narrow requirements as regards nitrogenous food as do the higher animals, and for some species the requirements are even still more specialised On the other hand, the *Streptobacteria* are satisfied with ammonia salts and a trace of cysteine, and the *Streptococci* even with ammonia salts as the sole source of nitrogen

A detailed report will be published shortly.

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Origin of Chemistry: the Definition of Flame

IN a recent publication[1] I have shown that practically all the technical achievements on the chemical side which have been credited to the Classical Period, to the Middle Ages, or even (by the least instructed) to our own times, in reality go back to the much earlier civilisations, the crafts of which were largely destroyed by the irruption of the people of the Iron Age, those cruder but better armed ancestors of many of the present inhabitants of Europe.

In my further investigations of the development of chemistry proper, which will form the subject of another work to be published before long, the same dependence on earlier periods is abundantly evident. An interesting example is provided by the definition of flame. Most of the histories of chemistry attribute to van Helmont (1577–1644) the statement that "flame is burning smoke". Kopp[2] (who is probably the origin of their information), however, pointed out in the corrections to his "History of Chemistry" that the statement occurs in Albertus Magnus (1193–1280)[3], which "is notable for its time". It goes back, of course, at least to Aristotle[4], but an interesting link with van Helmont is the statement in Albertus[5], which is also taken from Aristotle, that "flame is burning or ignited *spirit* or smoke" (flamma est spiritus sive fumus succensus sive combustus), in which the approach to van Helmont's definition of gas[6] (hunc spiritum incognitum hactenus, novo nomine *gas* voco) is clear.

It is also generally overlooked that Albertus describes[7] the inflammability of intestinal gases, again anticipating van Helmont. The work "De Alchimia" attributed to Albertus, from which much of the information as to his contributions to chemistry has been taken by the historians, is clearly much interpolated in the form in which it is printed[8], but parts of it are contained in old manuscripts[9] and parts are also extracts from his authentic works. One of the main sources of information on alchemy in Albertus's time was the treatise "De Anima" attributed to Avicenna[10], and practically all the information in European authors was then of Arabic origin. If the authorship of a Latin treatise of this time is unknown, then, provided it is of a well recognisable type, it may be safely regarded as Arabic. Further details will be given in my forthcoming work.

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[1] Partington, "Origins and Development of Applied Chemistry", Longmans, 1935, pp. xii+597.

[2] "Beiträge zur Geschichte der Chemie", 3 parts, Braunschweig, 1869–75, iii, 84. Kopp, *ibid.*, 70, is in error when he says Geber's name is not quoted by Albertus, since 'Geber Hispalensis' is mentioned in "De Mineralibus", II, ii, 3, but since the passage deals with gems, not alchemy, probably Jabir is not meant.

[3] "Meteororum", I, iii, 5; IV, iii, 17; Opera omnia, ed. Borgnet, 38 vols., Paris, 1890–99, vol. iv, pp. 504, 787.

[4] "De Coelo", ii, 4. "Meteorologicorum", iv, 9; the word 'φλογιστά', *phlogista*, occurs frequently in the latter work, for example, ed. Fobes, 1918, 387*b* ff., and Stahl's views are much less original than is commonly supposed.

[5] "Meteor.", IV, iii, 17; Borgnet, iv, 787.

[6] "Complexionum atque mistionum elementalium figmentum", Ortus Medicinae, Amsterdam, 1648, p. 106; 2 ed., Venice, 1651, p. 66.

[7] "Meteororum, III, iii, 4; Borgnet, iv, 643: sicut est videre in ventositate sicca egrediente de ventro hominis: haec enim si per pannum subtilem emittatur, et candela adhibeatur tota inflammatur flamma lata et dispersa; also in "Philosophia Pauperum", Pars IV, cap. 17; Borgnet, v, 491: this is the origin of van Helmont's *gas pingue*.

[8] Borgnet, xxxvii, 545–573; the text is merely a reprint of that in vol. xxi of the edition of Jammy, Lugduni, 1651, and is obviously based on a very late, 16th cent., manuscript.

[9] Brit. Mus. Sloane 323, fols. 61 ff., 14th cent.

[10] Also extensively used and quoted by Roger Bacon.

Influence of High-Frequency Field on the Combustion of an Acetylene – Air Mixture

THE investigation of the processes of the combustion of gas mixtures in a high-frequency electric field by Haber[1] and later by A. Malinowski and ourselves[2] led to the conclusion that the influence of a high-frequency field (10^6 sec.$^{-1}$) in reducing combustion velocity is approximately half that of a constant electric field of the same strength acting under similar conditions.

A. Malinowski maintains the view that this effect is due to the different efficiencies of the two types of field in removing active centres (ions and electrons) from the combustion zone of the gas mixture.

Our further investigations on the dependence of the field frequency and the velocity of combustion have established the fact that increasing field frequency results in a decreasing effect of the field. As can be seen from the accompanying table, at sufficiently high frequencies the effect of the field becomes negligible.

Electric field (670–700 volt/cm.)	Frequency	Decrease of the velocity of combustion (per cent)
Constant	—	9·00
Alternating	1×10^5	6·70
,,	6×10^5	3·37
,,	5×10^6	1·70
,,	8×10^6	0·57

Increasing the frequency of the field further, we discovered an opposite effect, that is, not the diminishing of the velocity of the combustion, but on the contrary its acceleration. This effect was observed at a frequency of $1 \cdot 8 \times 10^7$ sec.$^{-1}$. Passing into the region of ultra short wave-lengths, the acceleration increases and reaches finally 20 per cent at the frequency $3 \cdot 4 \times 10^7$ sec.$^{-1}$.

We presume this effect to be due to a sort of resonance energy exchange between the electrons and molecules of a reacting mixture.

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[1] F. Haber, *Z. angew. Chemie*, **42**, 745; 1929.

[2] A. Malinowski, W. Rossichin and W. Timkowski, *Sow. Phys.*, **5**, 212, 902; 1934.

Twinning in Alpha Iron

ABUNDANT twinning has been observed in pure alpha iron (carbon 0·0022 per cent, silicon 0·0018 per cent) which has been passed slowly through the critical range, and also in pure alpha iron deformed and then recrystallised below the critical range. In the former, banded structures are common; in the latter, banded structures are the exception. However, the forms or habits of annealing twins in alpha iron are quite distinctive.

Orientation relationships of individual grains were established by means of a back-reflection Laue X-ray method which I have developed. The only twin relation observed was of the type ordinarily described as (112) twinning. This twinning, considered symmetrically, is, of course, identical with the octahedral twinning commonly observed in metals of the face-centred cubic lattice.

It was also observed that the formation of alpha iron upon cooling through the critical range involves the genesis of macromosaic structure, probably subsequent to the twin formation—analogous to the behaviour of copper upon solidifying. It is believed that the forms assumed by the various constituents in steel, in particular the so-called Widmanstätten figures observed in alpha iron after quenching from above the critical range, are the result of the twinning and macromosaic lattice movements rather than of the crystallographic uniformity of the gamma-to-alpha transformation process, as was proposed by Mehl and Smith.

Results will be published at an early date.

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Pyrites in Quartz

PYRITES (FeS_2) in the form of small crystals and specks of a brassy-yellow colour may be found frequently in quartz. Four pieces of Brazilian quartz, containing pyrites inclusions, have now been found which are of unusual interest.

One of these pieces is a well shaped cap of good optical quality, very clear and completely devoid of feathers, 'smoke', etc., and containing three large pyrites crystals and a number of smaller ones. Their colour is almost a pure white and they have the characteristic pentagonal dodecahedron form and striated faces. It is very rarely that such fine inclusions are found in so clear a piece of quartz. The specimen is interesting also in that it has two beautifully etched faces.

A fifth specimen has also been found having a complete hole (approx. 10 × 4 × 8 mm.), in which a crystal doubtless at one time existed, for the faces of the hole are striated corresponding to the structure of the pyrites crystal. Unfortunately, in the process of working the quartz the hole was cut into, so that its vapour content escaped before an examination could be made.

A superficial examination indicates that the inclusions tend to lie in one particular plane through the quartz, and, further, the water inclusions in one of the specimens also lie in the same plane.

A fuller examination of the specimens is now in progress.

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May 3.

The Minimum in the Gamma Function

IT is well known that the gamma function $\Gamma(z)$ for real and positive values of z has a minimum between $z = 1{\cdot}46$ and $1{\cdot}47$. In a number of texts on the theory of functions it is stated that the minimum occurs at $z = 1{\cdot}4616321 \ldots$ and that the corresponding value of $\Gamma(z)$ is $0{\cdot}8856032 \ldots$. Only one text that we have examined, namely Joseph Edwards's monumental work "Integral Calculus", vol. 2, chap. xxiv (Macmillan, 1922), gives any indication of how the minimum points can be calculated. The method therein explained depends on certain properties of the gamma function and of the related logarithmic derivative $d \ln \Gamma(z+1)/dz$, commonly written $\psi(z)$, following Gauss. At best, the problem is finally one in successive approximation.

There is another approach to the problem, admittedly crude, but effective. Gauss ("Werke", 3, 161–162) left us a table of $\log \Gamma(z+1)$ to twenty decimals, and a table of its logarithmic derivative, $\psi(z)$, to eighteen decimals, by steps of $0{\cdot}01$ in the argument z between $z = 0$ and 1. It should be possible, then, by inverse interpolation in Gauss's table to find the value of z for which $\psi(z)$ vanishes. This value of z will be the abscissa of the minimum in $\Gamma(z+1)$, so that again by interpolation it should be possible to find the minimum value of $\log \Gamma(z+1)$. Finally, by Thompson's twenty place logarithms ("Tracts for Computers", No. 14, Cambridge, 1927) the minimum in $\Gamma(z)$ itself can be determined.

Using Everett's interpolation formula, and retaining sixth differences, we have in this manner found that the zero of $\psi(z)$, and hence the minimum in $\log \Gamma(z)$ and in $\Gamma(z)$ occurs at $z = 1{\cdot}46163\ 21449\ 68362\ 268$. Interpolation with the same formula gives the minimum of $\log \Gamma(z)$ equal to $\bar{1}{\cdot}94723\ 91743\ 93385\ 26292$, whence, by Thompson's logarithms, it turns out that the minimum of $\Gamma(z)$ is $0{\cdot}88560\ 31944\ 10888\ 68870$. In all of these values there is the usual likelihood of an error of a unit or so in the terminal digit.

It is interesting to notice that since we are here dealing with an extreme value of the gamma function, the value of $\Gamma(z)$ at the minimum is relatively insensitive to changes in z; hence, though it is not possible to determine z to more than eighteen decimals—the extent of Gauss's table of $\psi(z)$—the limit of accuracy in determining $\log \Gamma(z)$ is not z, but is Gauss's table of $\log \Gamma(z+1)$. Hence, our values of $\log \Gamma(z)$ and $\Gamma(z)$ should be correct except for the possibility of errors in the twentieth decimal, as mentioned above. As an illustration of this principle, it might be added that a change in z of one unit in the eleventh decimal place produces a change in $\log \Gamma(z)$ of a unit or so in the fifteenth place.

W. EDWARDS DEMING.

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CLARENCE G. COLCORD.

Bureau of Plant Industry,
U.S. Department of Agriculture,
Washington, D.C.

Light-Waves as Units of Length

I WISH to correct an error that occurs in my article on this subject in NATURE of March 30 (p. 496). The mean value of the wave-length of red cadmium in normal air from this table should be $6438{\cdot}4691 \times 10^{-10}$ metres, and not $6438{\cdot}4687 \times 10^{-10}$ metres, which is the mean of the last three determinations.

Originally I considered that only these later results should be used on account of the uncertainty, in the earlier work, regarding the carbon dioxide content of the air. Further consideration at the proof-reading stage led me to include the determination of Benoit, Fabry and Perot, in view of the probability that the actual lengths of the international substandards, No. 26 and T_3, were known to a greater accuracy with reference to the prototype metre than was the case with the various national standards. The correction was made in the proof, but the revised value for the mean was not inserted. The vacuum wave-length given at the end of the article was derived from this revised value, and therefore needs no alteration.

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May 2.

Points from Foregoing Letters

EXPERIMENTS with silver bombarded by neutrons and surrounded by air, water and liquid hydrogen, lead Prof. J. C. McLennan, Prof. E. F. Burton and Mr. A. Pitt to suggest that the radioactivity induced in silver is probably not affected by changes in temperature. Dr. P. B. Moon and Mr. J. R. Tillman find, on the other hand, that the radioactivity of silver, rhodium and iodine bombarded by neutrons which have traversed paraffin wax cooled with liquid oxygen, is appreciably different from the radioactivity obtained at ordinary temperature, being greater in the case of silver and rhodium and smaller in the case of hydrogen.

From the change in artificial radioactivity produced in spherical detectors of aluminium, silicon and phosphorus by neutrons slowed down after passing through heavy water, as compared with the effect produced after passing through ordinary water, Messrs. C. H. Collie, J. H. E. Griffiths and L. Szilard deduce that neutrons suffer a greater decrease in velocity on collision with nuclei of light hydrogen atoms (protons) than on colliding with the nuclei of heavy hydrogen atoms (diplons or deutons).

A 'decay curve' of silver activated by neutrons, slowed down by passage through paraffin, cannot be expressed as a single exponential curve, according to Seishi Kikuchi, Shigeo Nakagawa and Hiroo Aoki. They suggest as one possible explanation of results obtained by Bjerge and Westcott that, within certain limits, the yield of radioactive material decreases as the velocity of the exciting neutrons decreases, but below a certain velocity an increase in the yield takes place.

Dr. C. Hurst supports Klemperer's view that the natural radioactivity of potassium is due to a hitherto undetected isotope of mass 40. He calculates that a nuclear spin of only 2 or 3 units (instead of the 4 or 5 units postulated by Klemperer), would be sufficient to account for the slow period of decay.

The fact that both neutrons and positive electrons are emitted by lithium bombarded with α-particles leads Mr. H. J. Walke to expect that protons would also be given off. Delayed emission of 'negative' electrons should be observed from lithium and boron when bombarded by α-particles.

A supraconducting galvanometer has been constructed by Prof. E. F. Burton and Messrs. H. Grayson Smith and F. G. A. Tarr. They describe some experiments carried out with it, and indicate further fields of research in which the instrument would be useful.

From the percentage incidence of certain hereditary diseases (hæmophilia and epiloia), which have a high mortality ratio, Dr. L. S. Penrose and Prof. J. B. S. Haldane calculate that such diseases must arise as mutations, with a frequency of about 1 in 100,000.

Dr. Kenneth Smith directs the attention of horticulturists to the appearance of a new virus disease attacking tomato plants, and describes the symptoms which characterise the new disease.

Miss D. A. E. Garrod and Miss E. W. Gardner report the finding near Mount Karmo, Palestine, of flint implements in a layer of red earth within a deposit of wind-blown sandstone, hitherto thought to be a marine formation of Pliocene age. The implements are of Mousterian and Levallois type and the deposits in which they are found must belong to the late Pleistocene, a fact which is likely to lead to the revision of some of the current views concerning the age of other geological formations in Palestine.

The molecular polarisation of phenol in benzene has been measured from the dielectric constant and the density of its solutions by Dr. A. R. Martin. He finds that as the concentration is increased the molecular polarisation increases and then decreases, as it does in the case of the lower alcohols.

In the breakdown of sugar by fermenting peas, combination of the sugar with phosphoric acid appears to be a necessary step, according to experiments reported by Mr. M. S. Rao. In this respect, chemical reactions in higher plants seem to be similar to those in animal muscle.

Mr. S. H. Clarke points out that the crushing strength of ash timber when compressed parallel to the grain is roughly indicated by the colour that the wood stains with phloroglucin and hydrochloric acid. In strong specimens the fibre-walls stain red and in weaker types the middle lamella region stains a faint pink. The test has been used to detect weakness in hockey sticks.

In view of the fact that X-ray analysis shows potassium, cæsium and methyl-ammonium alums, previously considered isomorphous, to have in reality different structures, Mr. H. Lipson raises the question whether similar differences of structure may not exist in other supposedly isomorphous series. He concludes that such pseudo isomorphism is only likely to occur in crystals of the cubic system.

The electrical conductivity of heavy oils and of paraffin wax, in the neighbourhood of melting point, rises with decreasing temperature. This abnormal behaviour, Dr. A. Gemant suggests, may be due to progressive crystallisation with decreasing temperature, the substances considered behaving as two phase systems.

The spectra of light scattered by ordinary acetic acid and by the corresponding compound containing heavy hydrogen, have been investigated by Messrs. W. R. Angus, A. H. Leckie and C. L. Wilson. From the displacement observed in some of the spectrum lines, they tentatively connect those lines with the known valency links between atoms (C—H, O—H, C—C, C—O).

The absorption of infra-red light by crystalline sodium nitrite has been determined by Messrs. C. R. Bailey and J. W. Thompson. Its relation to the light scattered by sodium nitrite crystals and solution gives an indication of the arrangement of the atoms and the molecular forces involved.

A high frequency discharge through selenium vapour has yielded light attributed by Messrs. B. Rosen and M. Désirant to the excitation of the Se_2 group in the polyatomic molecules of selenium.

The effect of a high-frequency electric field upon the combustion rate of a mixture of acetylene and air is reported by Messrs. W. Rossichin and W. Timkowski. They find that an increase in frequency between 10^5 and 10^7 sec $^{-1}$ causes a decrease in the velocity of combustion, but with higher frequencies the effect is reversed.

News and Views

Prof Graham Kerr and Parliamentary Representation

THE appointment of Mr John Buchan as Governor General of Canada necessitates a by-election for a representative of the Scottish universities in the House of Commons We are very glad to see that Prof J. Graham Kerr, regius professor of zoology in the University of Glasgow, has been adopted as a candidate by the Unionist Association of the Universities of Edinburgh, Glasgow, Aberdeen and St Andrews It would be difficult to find a man of science who could more worthily represent the Scottish universities in Parliament than Prof Kerr He combines long experience of the teaching and administrative sides of these universities with wide scientific interests and a high position in the political field, being president of the Scottish Unionist Association, chairman of the Glasgow Unionist Association, and holding similar offices in other Unionist organisations Prof Kerr's election to Parliament would involve considerable self-sacrifice, for it would mean the giving up of the life tenure of his chair of regius professor of zoology in the University of Glasgow In these days, when the whole of our communal existence is permeated by science and its applications, it is the duty of scientific workers to take an active part in shaping the destinies of the nation by promoting the election into the House of Commons of representatives having scientific knowledge and outlook At present there is not a single fellow of the Royal Society in the House of Commons, and if, as we hope and expect, the Scottish universities return Prof Graham Kerr as their member, they will be rendering a notable service to science and the nation

Ergometrine, a New Alkaloid from Ergot

THE clinical observations of Moir (*Brit. Med J*, i, 1119, 1932), that aqueous extracts of ergot are more effective in producing the uterine contractions to which this drug owes its medicinal use than are any of the known ergot alkaloids, for example, ergotinine, ergotoxine, ergotamine, has recently led to the isolation by H W Dudley and C Moir (*Brit Med J*, March 16, 1935) of a new ergot alkaloid which promises to become of great importance in obstetric practice The new alkaloid, termed ergometrine, is a crystalline, water soluble base, of which 0·82 gm was obtained from 10 kgm of defatted ergot Oral administration of ergometrine, in a dose of 0·5–1·0 mgm, produces strong uterine contractions after 6½–8 minutes By way of contrast, doses as large as 2–3 mgm of ergotoxine and ergotamine, given by mouth, have a relatively feeble oxytocic effect after an interval of 35 minutes or more, and a similar type of activity is shown by the recently discovered ergot alkaloids, sensibamine and ergoclavine. Even when given by injection, the ergotoxine-ergotamine alkaloids are rather slow in action, and often produce such unpleasant symptoms as headaches, nausea and depression Ergometrine is stated to be free from these undesirable subsidiary effects.

A SAMPLE tube has been sent to us of ergometrine as manufactured in the laboratories of British Drug Houses, Ltd, and supplied in tablets containing 0 5 mgm, suitable for oral administration It is astonishing that the recognition of this active principle of ergot should have been so long delayed, and it may be that even more valuable secrets will ultimately be disclosed by this remarkable parasitic mould, the investigation of which has already yielded ergosterol and its irradiation products, including artificial vitamin D Further reports on the pharmacology and chemistry of ergometrine will be awaited with considerable interest In the issue of the *Lancet* of May 25 (p 1243), M S Kharasch and R R Legault discuss the possibility that ergometrine may be identical with, or closely related to, the ergotocine recently isolated by these workers and their collaborators (*Amer J Obst and Gyn*, February, 1935, p 155) Pure crystalline ergotocine is being manufactured in large quantities by the Eli Lilly Company, the recommended clinical dose for oral administration being 0·4 mgm

Prof P. Lenard of the University of Heidelberg

THE Physical Institute of the University of Heidelberg has recently, in honour of Prof Lenard, been renamed the 'Philipp Lenard Institut' A correspondent has sent us a cutting from the students' magazine of that University, giving Prof Lenard's reply to the congratulations of the Heidelberg students on this occasion The following is a translation of Prof Lenard's reply, and we prefer to make no comment upon it —"I am very grateful to the students of the University of Heidelberg for their congratulations on the renaming, by the Ministry, of the Institute which was built some years ago under my direction I hope that the Institute may stand as a battle flag against the Asiatic Spirit in Science Our Leader has eliminated this same spirit in politics and national economy—where it is known as Marxism In natural science, however, with the over-emphasis of Einstein, it still holds sway We must recognise that it is unworthy of a German,—and indeed only harmful to him—to be the intellectual follower of a Jew Natural science properly so called is of completely Aryan origin and Germans must to day also find their own way out into the unknown. Heil, Hitler!"

Rationalisation of Scientific Publication

A POINT raised in the leading article in NATURE of March 9 on the subject of "Rationalisation of Scientific Publication", relating to the duplication of abstracts, led Dr Ainsworth Mitchell to state the views of the Society of Public Analysts in a letter published in our issue of May 11, p 791 Further communications have since reached us from other members of the Society. The main contention is that the Society produces at its own cost something for the use of its members which is not supplied by the British Chemical Abstracts; and that these specialised abstracts are widely appreciated. In so far as a large number of members of the Society of Public Analysts are members also of one or both of the societies maintaining the Bureau of Chemical Abstracts, no reasonable objection can be raised to this action. None the less, the unprejudiced onlooker may regret the example when overlapping and duplication are still so widely apparent in chemical literature, and when the major scientific societies find the burden of publication a severe tax on their resources. He may still be entitled to conclude that it is idle to deplore such financial limitations or to lament the growing difficulty which besets every scientific worker of keeping abreast of his subject until there is to be found a much greater willingness to make generous sacrifices in the general interest. It is unfortunate that a phrase in the original article, intended merely to indicate the ground covered by the abstracts of the Society of Public Analysts, has been construed to refer to the matter and data of the abstracts in a way which the Society would have been justly entitled to resent. Such criticism of any society is, however, most effectively disarmed by the measure in which the Society publicly as well as privately supports the central institutions for the co-ordination of scientific literature in the particular science it avows.

Export of Antiquities from Egypt

A REPORT from Cairo points to the possibility of further restrictions on the export of antiquities from Egypt. Under the existing antiquities law, which has been in operation for a little more than a decade, the rights of the State in the allocation of the proceeds of legitimate excavation have been well—indeed some would say too well—protected, but it has proved difficult to check clandestine digging. The finds from these illicit activities frequently, but not invariably, find a final resting place in the Cairo museum, but a considerable number still are smuggled out of the country. According to a dispatch from the Cairo correspondent of *The Times* in the issue of May 25, violent protest has been raised in the Arab newspapers as a result of reports of the value of papyri, and especially of the new fragments of a Gospel now in the British Museum, which have been sold at high prices to European collections. Inquiries by *The Times* correspondent have elicited the admission that sales by Cairo dealers to private collectors have been due to the fact that the Cairo Museum has not shown an interest in papyri except when of historical importance. As a consequence of this agitation, however, the Minister of Education, Nequid Bey Hilali, has appointed a committee to inquire into the question of illicit sales of antiquities. Although archæologists may sometimes have felt the burden of the regulations imposed upon legitimate excavation to be unduly irksome, they will have no quarrel with any measure checking that destruction of scientific evidence which is the inevitable accompaniment of clandestine digging and illicit sales.

Control of Architecture

THOUGH a nation may not be judged wholly by its architecture, this at least forms an outward and visible sign of its mentality, and since many buildings outlive a number of generations, it is our duty to posterity to see that the structures we erect are not only fitted for their purposes, but also are outwardly gracious and in harmony with their surroundings. Great developments in building are in progress, municipal, institutional, commercial and most of all domestic owing to the programmes of slum clearance. These developments merit the employment of only qualified architects, to ensure the greatest economy in the expenditure of money and the most suitable results in design which proper training can alone give. The Royal Institute of British Architects sent last January to the Minister of Health a memorial expressing the readiness of the architectural profession to give assistance in the matter of slum clearance schemes, and pointing out that many of the local authority staffs have neither the time nor the experience to deal adequately with these large problems. Most people will admit the wisdom of employing a properly qualified professional man for any service, be it medical, legal or architectural, and the suggestion that public money should only be spent under competent professional advice appears to be sound reasoning. A great deal of time is given gratuitously by architects in serving on panels to assist in the improvement of designs submitted to local authorities, and through a very complete system of professional education the advice and service of competent men is now obtainable in all parts of the country.

Recent Acquisitions at the British Museum (Natural History)

OF all the regions of the world, the Pacific coast of South America is, perhaps, the most poorly represented in the Museum collection of fishes, and a representative series of the marine fishes of Chile has long been required. Through the kindness of Mr. V. Cavendish-Bentinck, of the British Embassy at Santiago, arrangements have been made with the Chilean fisheries authorities to supply the Department of Zoology with well-preserved specimens of the more important fishes. The first consignment of what promises to be a collection of considerable importance has now been received, and another consisting of specimens collected in the Juan Fernandez Islands is expected within a few weeks. Among the specimens acquired by exchange for the Zoological Department are examples of the Hawaiian land snail *Achatinella*. The species and races of these snails, which are often restricted to single ridges and ravines (in some cases even to single trees), are classical examples of the effects of isolation in species-formation. The Department of Mineralogy has acquired by purchase a remarkable set of 98 meteoric stones which fell in 1869 as a shower at Tenham station, Kyabra County, South-West Queensland, and are as yet undescribed. Another purchase is a fine doubly-terminated crystal of ruby and a faceted colourless chrysoberyl (7·15 carats) from the ruby mines at Mogok, Upper Burma. Chrysoberyl is usually of pronounced colours, the variety alexandrite, for example, being green by daylight and red by lamp-light, and a colourless gem of this species has not previously been recorded.

The Department of Botany has received more than 2,900 numbers as a result of the British Museum Expedition to East Africa. These were collected by Dr. G. Taylor, assistant keeper in the Department; some additional numbers collected by Mr. P. M. Synge have not yet arrived. Four groups of mountains were visited—Aberdare, Beringa, Ruwenzori and Elgon. The longest period was spent on Ruwenzori itself, and extensive collections were made in the Namwamba valley up to the snow line; the plants from the adjoining Nyamgassani valley, where Mr. Synge collected, will afford an interesting floristic comparison. Although main attention was paid to the mountains, the flora of the plains was worked so far as possible, and the aquatic flora from the rivers yielded much of interest in relation to researches being carried out in the Department. It is not possible to give an analysis of the collection at present, but it contains several new species and a large number of plants not previously represented in the Museum. The herbarium of William Rashleigh (1777–1855) was recently purchased from a second-hand bookseller. This is entirely of seaweeds and is contained in three volumes. Its main interest is that it contains the herbarium of John Stackhouse (1742–1819) the author of "Nereis Britannica" (1795–1801) in which some of the first post-Linnean genera of algæ were published. Some years ago, an effort was made to trace the herbarium in order to clear up some points which had arisen regarding nomenclature, but nothing could be learned beyond the fact that it had been bequeathed to Rashleigh. The collection was offered for sale in the ordinary way. A small volume of mosses collected by Dr. W. K. Kane on the U.S. Grinnell expedition in search of Sir J. Franklin (1853–55) has been purchased. These were apparently the original set of the "Kane Portfolio" arranged by T. P. James. Most of the cryptogams collected on the expedition were lost when the vessel was abandoned.

Linnean Society of London

At the anniversary meeting of the Linnean Society of London held on May 24, the president, Dr. W. T. Calman, delivered a presidential address, "The Meaning of Biological Classification". The Linnean Gold Medal was presented to Sir David Prain, a past-president of the Society, in recognition of his services to botany. In making the presentation, Dr. Calman mentioned that Sir David began his scientific work as a member of that great service which has produced so many eminent naturalists, the Indian Medical Service, that he became the head of Indian botany when he was superintendent of the Botanical Survey of India and of the Royal Botanical Gardens, Calcutta. When Sir David returned to England, he became director of the Royal Botanic Gardens at Kew, an office which he filled with conspicuous success until his retirement in 1922. But although his success as an administrator has been conspicuous, he has never forgotten that the business of a scientific man is scientific research, and his contributions to systematic botany, particularly that of the Indian Empire, are of a kind that would have gladdened the heart of Linnæus himself. The following officers were elected for the year 1935–36: *President*, Dr. W. T. Calman; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. John Ramsbottom (botany), and Dr. Stanley Kemp (zoology). The new members of the Council are Dr. B. Barnes, Mr. D. J. Scourfield, Lieut.-Colonel R. B. Seymour Sewell, Mr. W. H. Wilkins and Dr. E. B. Worthington. The president announced that he had appointed the following vice-presidents: Prof. G. D. Hale Carpenter, Mr. Francis Druce, Dr. Margery Knight and Prof. Macgregor Skene.

Temperament in Industry

Prof. Major Greenwood delivered the second of his Heath Clark Lectures, under the auspices of the National Institute of Industrial Psychology, on May 20, on "Temperaments, Physical and Psychological, in Modern Science". He pointed out that the ancient physicians were deeply conscious that differences of temperament entailed psychological consequences which expressed themselves in bodily as well as mental reactions, and that it was the duty of the physician to diagnose and treat these conditions. In Great Britain the work of Kretschmer has received considerable attention, but the infinitely clearer and scientifically more rigorous work of Boldrino and the Italian School has been unduly neglected. Boldrino has shown that it is probable that certain morphological types, roughly corresponding to the old ‘sanguine’ and ‘melancholics’, do differ in resistance to such diseases as tuberculosis, in distribution through the social classes, and even in fertility, but in respect of psychological characters there is much less evidence of any such relation. Prof. Greenwood considered the claims of some modern work on temperament that had relied on statistical correlations; he emphasised that statistical description is fundamentally group-description only, and has little diagnostic value in individual cases. He illustrated this by data on accidents, and showed that, while the application of tests would undoubtedly eliminate many likely to be accident prone, yet they would also eliminate some who are not, and so do an injustice to individuals. Although Prof. Greenwood feels that, with respect to a finer gradation of temperamental qualities, we are indefinitely far from any fool-proof system of routine testing, yet we may be near to the time when an elimination of extreme variants on a basis of temperamental tests will be practicable.

Poisons and their Detection

Dr. G. Roche Lynch delivered the thirtieth Bedson Lecture in Newcastle upon-Tyne on May 16. After a brief outline of the history of poisoning from ancient times up to the beginning of scientific investigation with Marsh, about a century ago, and Stas in 1850, Dr. Roche Lynch discussed the general characteristics of poisons. With the exception of a few of animal origin, like snake venom and certain serums, tolerance toward all poisons increases with repeated small doses; narcotics, alkaloids, metals and even castor oil. This seems to be due to growing immunity of the cells as well as to increased rate of excretion or destruction. In general, detoxication takes place mainly in the liver with increasing efficiency, the processes seeming to be developments of natural responses. Quite large amounts of the heavy metals have been found, lead up to 146 parts per million being demonstrated in normal bone where no industrial or similar causative contact had occurred. Difficulty arises with the modern synthetic medicinals, they have often only a narrow margin between the medicinal and the toxic doses and have little allowance for idiosyncrasy. Many of them are completely destroyed, or changed in the tissues into something else in a short time. The barbituric acid group are particularly dangerous, and should be brought under regulation. They are all hypnotics but their behaviour from a toxicological point of view is very different. Some of these compounds are almost completely destroyed in the body, so that analysis only reveals a trace, and others are readily found in considerable quantity both in the excreta and in the organs. Opinion therefore as to the cause of death must depend on the type of barbiturate present and the amount isolated. Dr. Lynch then dealt in greater detail with arsenic, strychnine and carbon monoxide, illustrating his remarks with references to, and exhibits from, famous criminal cases.

Conservation of the Flora of Great Britain

IN the report of the work of Flora's League, a society for the preservation of wild flowers, ferns and trees, covering the years 1932–34, the League records its work, in collaboration with other bodies, for the conservation of the British flora, and its plans for the future. In co-operation with the Cotteswold Naturalists' Field Club, the Gloucestershire station of *Ranunculus ophioglossifolius*, which grows in this and one other county only in England, has been secured for all time, while in Lancashire special efforts are being made to preserve the endangered flora of the sand-dunes in the vicinity of Ainsdale, the only known habitat of *Epipactis dunensis*. Following on the successful re-introduction of *Maianthemum biflorum*, the may lily, in Ken Wood, under the direction of Mr. J. S. L. Gilmour, assistant director of the Royal Botanic Gardens, Kew, the League has plans for the cultivation of rare species of wild-plants for their seeds, to sow in wild flower gardens or in haunts from which they have disappeared; though record of the site and other details of each such experiment will be reported to the Department of Botany of the British Museum (Natural History) to avoid any confusion of records of field botanists. Under the auspices of the Wild Plant Conservation Board of the Council for the Preservation of Rural England, the British Wild Plant Nurseries and Seed Exchange Agency has been originated by Mr. C. S. Garret at Derby, for this purpose, but not to be run as a commercial profit-making concern; while the Green Cross Society and the British Empire Naturalists' Association, affiliated organisations, have similar seed-distributing schemes. The president and founder of the League is Sir Maurice Abbot Anderson, and it has offices at the Council for the Preservation of Rural England at 17, Great Marlborough Street, London, W.1.

Meteorology in Northern Rhodesia

THE Meteorological Report for Northern Rhodesia for 1931–32 (No. 9) is the first of this series that has appeared since responsibility for the direction of meteorological work in that colony was taken over by the Director of the British East African Meteorological Service (Mr. A. Walter), for although the new service was officially inaugurated in 1929, it was not until the end of 1931 that Northern Rhodesia was included in it, control being meanwhile in the hands of the Director of Surveys. The new regime began soon after the completion of the Territorial First Order Meteorological Station at Broken Hill—a station exactly similar to the other first order stations already established in Kenya, Tanganyika and Uganda. Before the end of the year, autographic records of temperature, humidity and atmospheric pressure were in operation there, and were used for obtaining the hourly readings of these elements that appear in this report for the six months January–June 1932. The work of Broken Hill includes the distribution of forms and equipment to the subsidiary stations within the colony, the handling of all the records obtained at such stations, and the issuing of weather reports, including the results of pilot balloon ascents, to aeroplanes passing over Northern Rhodesia. The report is on the same general lines as the earlier annual reports; it includes, in addition to statistical tables on normal lines, discussions of the separate meteorological elements, among which rainfall, as in the tropics generally, is of the greatest immediate practical importance. There is in addition an account of a waterspout that was seen near Nsalushi Island, in the swamp area of Lake Bangweolo, on February 19, 1932, and particulars of slight earth tremors reported from a number of subsidiary climatological stations.

Distributing Electricity to Country Districts

DURING the last ten years, the distribution of electricity by means of overhead lines has made rapid progress; but there are still nearly 80 per cent of the occupied rural areas of England where electric supply is not available. There is a vast amount of development work to be done in these areas. Already the capital sunk for distributing power is considerably in excess of that used for generating power. The annual expense in distribution is at the present time three times greater than that for generation. The progress already made shows that there is plenty of scope for technical improvements which would increase the factor of safety and lower the cost of supply. The rural schemes already installed prove that an overhead distribution at 11,000 volts (11 kv.) is economical when the loads are small. When heavier loads are anticipated, 33 kv. is generally adopted. In a paper by R. Dean read to the Institution of Electrical Engineers on May 15, the available data relating to rural design have been collected and the many numerical tables given will enable engineers to obviate many tedious calculations. Official regulations and a number of practical details in design are also given. For rural supply, it has been found that wood poles are the best. Both concrete and steel poles are about 12 per cent more expensive. The admissible factor of safety for wood poles has now been reduced to 3·5. At the time of constructing the 132 kv. grid, steel-cored aluminium was the most popular conductor to use, but the author's tables show that copper-cored steel or steel cored copper provide rather cheaper lines. The requisite experience has not yet been obtained of the effects of electro chemical action on these lines after a number of years exposure to the weather. There are many subsidiary advantages in favour of steel cored aluminium for high-voltage lines.

Prof. Patrick Abercrombie

THE University of Liverpool gave London its first professor of town planning in Prof. S. D. Adshead, who has held the chair of town planning in the Bartlett School of Architecture at University College since 1914. The University of London is fortunate in securing as his successor Prof. Patrick Abercrombie, who since 1915 has been Lever professor of civic design at Liverpool. During these last twenty years he has been engaged in educating town planners, and has himself been a leader in every movement for the improvement and preservation of town and country alike. His interest in planning is not confined to town and industrial areas: he was one of the three mainly concerned in the founding of the Council for the Preservation of Rural England, and his work there has shown the necessity of proceeding by country preservation to country planning, and finally to national planning. He has recently been appointed to prepare the plans for a national park in Snowdonia. The series of town planning schemes published by the University Press of Liverpool, the *Town Planning Review* started in 1910 and issued for the last twenty-five years under his editorship, form a fine written and pictorial record not only of the work of Prof. Abercrombie himself, but also of all those who have devoted themselves to these problems during recent years.

Health of the Army during 1933

LIEUT.-GEN. J. A. HARTIGAN, Director-General of the Army Medical Services, details in his first report, recently issued, the health of the Army at home and abroad for the year 1933 (H.M. Stationery Office. 2*s*. 6*d*. net.) The total strength at home and abroad was 184,000 men. The general health of all ranks fell little short of the high level reached in 1932, some increase in the admission rate being almost wholly accounted for by an increase in the incidence of influenza. The chief causes of death were injury, tuberculosis, pneumonia and suicide, and of invaliding, tuberculosis and inflammation of the middle ear. Venereal diseases have again diminished, but tonsillitis still claims a number of victims and has slightly increased. The admissions for diphtheria show a welcome reduction, and it is remarked that at the depots at Caterham and Woolwich, where Schick testing and immunisation when necessary are carried out as a routine, the disease is practically non-existent. In addition to the statistics, details are given of the various measures that are being adopted at home and abroad for the prevention of disease.

Conference on Atmospheric Pollution

THIRTY-SIX representatives of local authorities and other organisations co-operating with the Department of Scientific and Industrial Research in the investigation of atmospheric pollution met on May 27 in the half yearly conference on atmospheric pollution at the offices of the Department. A report was received from Dr. G. M. B. Dobson on the progress of the researches carried out under the Atmospheric Pollution Research Committee. Dr. Dobson informed the conference that a full time investigator has been appointed by the Department as a preliminary to the undertaking of an intensive survey, at a selected centre, of various types of pollution with a larger number of instruments. The method developed at the Building Research Station for estimating sulphur in the atmosphere is now being adopted more widely by the local authorities. Further experiments combined with weather observations are being taken in hand to facilitate the interpretation of the data collected by means of the deposit gauge observations.

Lister Institute of Preventive Medicine

AT the general meeting of the members of the Lister Institute of Preventive Medicine, which was held on May 21, the governing body presented the Institute's forty-first annual report. This report contains an excellent summary of the important research work carried out in the laboratories and Serum Department during the past year. The amount of research seems to be more voluminous than usual, and the list of communications published occupies several pages. With the aid of a grant of £3,400 by the Rockefeller Foundation, a Svedberg velocity and equilibrium centrifuge is to be installed, a new and valuable equipment that should find useful application in protein, virus and other researches.

Czechoslovak Institute for the Study of Sound

AN institute for the study of sound has just been established in Prague under the management of Profs. K. Teige, M. Seemen and V. Vojtěch. The purpose of the institute will be to bring together scientific and practical workers to investigate sound in its physical, technical and physiological aspects. In pursuit of these aims it is proposed to arrange inquiries, excursions, lectures, both scientific and popular, and to carry out experiments and publish the results. The first important step to be taken in this connexion will be the equipment of a research laboratory, and one of the first tasks of the institute will be to investigate noise and the methods of dealing with it. Another subject for early inquiry will be the technique of musical instruments

Announcements

THE Langley Medal for aerodromics of the Smithsonian Institution was presented on May 21 to Dr Joseph S Ames, of Johns Hopkins University, who is chairman of the National Advisory Committee for Aeronautics The award was made "in recognition of the surpassing improvement of the performance, efficiency, and safety of American aircraft resulting from the fundamental scientific researches conducted by the National Advisory Committee for Aeronautics under the leadership of Dr Ames"

THE Executive Council of the Universities Bureau of the British Empire has had before it nine nominations from Conferences of Universities overseas for the Carnegie Corporation Grants to the value of £400 each for the year 1935-36 A Selection Committee scrutinised these nominations and on May 25 the Executive Council approved the decision of this Committee to award these grants to Prof T J Haarhoff, of the University of the Witwatersrand, Prof T H Laby, of the University of Melbourne and Prof Meghnad Saha, of the University of Allahabad

THE curators of the Dr Martini fund have awarded the 1935 prize of 1,000 gold marks to Dr Carl, a former assistant at the Friedrichberg State Hospital, and at present senior physician in the serological and bacteriological department of the hospital, for a work on adenylacid metabolism in normal persons and the insane and in the brain of animals

THE annual visitation of the National Physical Laboratory, Teddington, Middlesex, will take place on Tuesday, June 25, at 3–6 p m

AT the annual general meeting of the British Science Guild, to be held on June 12 at 4 30 p m, a lecture on "Gas Defence" will be given by Mr J Davidson Pratt, general manager and secretary of the Association of British Chemical Manufacturers The meeting will take place in the lecture theatre of the Royal Society of Arts, John Street, Adelphi, London, W C 2, and tickets (for which there is no charge) may be obtained on application to the Secretary of the British Science Guild, 6 John Street, Adelphi, London, W C 2

THE fourteenth annual congress known as the Journeés médicales de Bruxelles will be held at Brussels from June 29–July 3, that is, while the International Exhibition is still open The inaugural address will be delivered by Prof Loeper, of Paris, on music and medicine. The subscription is 100 francs. Further information can be obtained from the general secretary, Dr. René Beckers, 141 rue Belliard, Brussels.

MESSRS. WHELDON AND WESLEY have recently issued Catalogue No. 40 of books, periodicals and pamphlets on geology, palæontology, mineralogy and mining Upwards of 1,300 items are listed, including many older works of historical interest Among the periodicals may be mentioned an exceptionally long run of the *Annales des Mines*, from its commencement in 1795 (as the *Journal des Mines*) down to 1918 There is also listed a large number of the *Memoirs of the Geological Survey* of Great Britain, and of the bulletins and monographs of the United States Geological Survey. The pamphlets include many extracted from early volumes of the *Philosophical Transactions of the Royal Society*

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An engineer at the Building Research Station, Garston, near Watford—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (June 4) A lecturer in mechanical engineering in the St Helens Municipal Technical School—The Secretary for Education, Education Office, St Helens (June 7). A temporary demonstrator in botany in the University College of Wales, Aberystwyth—The Secretary (June 8) A lecturer in mining in the Heanor Mining and Technical School—W G Briggs, Director of Education, Derby (June 8) A lecturer in mathematics in Merchant Venturers' Technical College, Bristol—The Registrar (June 11) A junior in the Records Section of the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W 1 (June 11) A lecturer in the Department of Civil and Mechanical Engineering, King's College, Strand, London, W C 2—The Secretary (June 12) A woman lecturer in biology and the teaching of biology in the Department of Education, University of Birmingham—The Secretary (June 13) A lecturer in mathematics, a lecturer in science and a lecturer in general education at the Royal Military Academy, Woolwich—The Under-Secretary of State (C 5), The War Office, London, S W.1 (June 15). A lecturer in mathematics, a lecturer in botany and a lecturer in physiology in the Chelsea Polytechnic, London, S.W.3—The Principal (June 15). A Curator of the Public Museum and Art Gallery, Hastings—The Director of Education, 18 Wellington Square, Hastings (June 15) A lecturer in physics and mathematics in the Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (June 21). A lecturer in botany at the Imperial College of Science and Technology, London, S W 7—The Secretary (June 22). An assistant lecturer in chemistry in the University of Sheffield—The Registrar (June 22). A lecturer in electrical engineering at Loughborough College—The Registrar (June 30). Two University demonstrators in pathology in the University of Cambridge—Prof. H R. Dean (July 10). A part-time demonstrator in chemistry in the London (Royal Free Hospital) School of Medicine for Women —The Warden, 8 Hunter Street, Brunswick Square, W.C.1. A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

Research Items

Human Skeletons at Hythe. The skulls and long bones preserved in the ossuary of the church of St Leonard at Hythe, which were examined by Prof F G. Parsons nearly thirty years ago, have been subjected to further study by Dr G M Morant and Miss Stoessiger As a supplement to their report, which appeared in *Biometrika*, **24**, 1932, Dr Morant has now published a general account of the origin, history and character of the collection so far as his research has carried him ("The History of the Human Skeletons preserved in the Ossuary of the Church of St Leonard, Hythe." F J Parsons, Ltd Pp 41. 1*s* 6*d*) The place of their storage is neither crypt nor charnel-house, but a passage way under the chancel, made when the church was enlarged in the early thirteenth century, to serve as part of the processional path On the basis of the thigh-bones, the number of individuals represented is at least 4,000. Popular tradition attributes them to those slain in a battle fought in 456 A D between Britons and Saxons, or to Danes who landed in 843, or to French who raided the coast in 1295 An examination of the bones shows that they consist of an almost equal number of male and female and vary widely in range of age, children alone not being present It is concluded that they are the remains of inhabitants of the parish, extending over a considerable period of time, placed in the church for safe keeping after inhumation Anthropologically they present peculiar characteristics, for which the only known parallel in the British Isles is found in the skeletal remains of indeterminate age from Spitalfields in London, which were brought to light at the extension of the Fruit Market in 1926 This Spitalfields series bears a close resemblance to a series from Pompeii and to another of Etruscans of the Roman period from north Italy Not only does the Hythe type resemble that of Spitalfields closely, but it is also closely allied to modern series from Bologna, Czechoslovakia and Rumania The Spitalfields people were probably Roman inhabitants of London of Italian origin and it is, therefore, probable that the Hythe people are descendants of foreigners who settled in the locality in Roman times

Protective Habit of Desert Kangaroo Rat. Seth B Benson has observed that a desert kangaroo rat (*Dipodomys deserti*) brought into the neighbourhood of objects which it regarded with suspicion, kicked considerable volumes of sand upon them, apparently with the view of discovering whether they were alive (*J. Mamm.*, **16**, 67 ; 1935). During a period of about five minutes, it skirmished in front of the objects (in this case a pile of bread crusts), and the skirmish ended with the rat turning about, kicking sand upon the pile with force and precision by using its hind legs, and immediately whirling about to watch the effect of its storming. This action was repeated half a dozen times It explained why the author had previously found many of his small mammal traps set off and partially buried in the sand, because the amount of sand thrown and the force with which it was thrown were enough to effect these results. The suggestion is that this action is a defensive action likely to be of particular value against such an enemy as the sidewinder snake (*Crotalus cerastes*), which inhabits desert places and is known to feed upon kangaroo rats.

Researches upon the Tubercle Bacillus. Konrad E Birkhaug describes in two lengthy papers observations upon the general characters of several strains of the tubercle bacillus (*Ann de l'Institut Pasteur*, **54**, No 1, p 19, No 2, p 195, 1935) Avian, bovine and human strains show little difference in morphological characters, but are liable to dissociate spontaneously into three types of colonies, the *Ch* (chromogenic), *R* (rough), and *S* (smooth) For the avian strain, the *S* variety is the dominant type, and *Ch* and *R* varieties are relatively rare For the mammalian strains, the dominant type is the *R* variety, and the *S* and *Ch* varieties are rarer These varieties are not stable, but frequently change one into another both *in vivo* and *in vitro* The *Ch* and *S* varieties develop at laboratory temperature (20°- 30° C), but the *R* variety develops only at 37°–40° C , none of them develops anærobically The *R* varieties of the avian and mammalian strains are more resistant to dyes and disinfectants than the *Ch* and *S* varieties, but the latter are more resistant to heat and light than the former. The *Ch* variety of both avian and mammalian strains are generally avirulent to animals

A Brown Rot Fungus. The brown rot fungi of tree fruits have received considerable attention of late years Various species of the genus *Sclerotinia* are the chief causal fungi, but a brown-spored discomycete, *Lambertella Corni-maris*, has recently been found to produce brown rot symptoms upon a variety of fruits and vegetables (T H Harrison and A F Helaly, *Trans. Brit Mycol Soc*, 19, Part 3, 199–214, February 1935) Dr Harrison made a tour of some of the fruit areas of western Europe in 1931, and found apothecia of a fungus upon mummified pears in Switzerland and south Germany They seemed to be characteristic of *Sclerotinia cinerea*, but were identified by Mr S P Wiltshire as the fungus named above Dr El-Helaly made cultural studies of the fungus, which tolerates a wide range of acidity, and produces fruit bodies upon a variety of media. It excretes pectinase and oxidising enzymes, and induces disease upon apple, pear, plum, quince, orange, lemon, turnip and parsnip

Insect Pests of Lavender Dr H F Barnes, of Rothamsted Experimental Station, has recently published a discussion on "Lavender Pests" (*J. Roy Hort Soc*, March 1935) Few caterpillars were known to attack this fragrant crop, but the present article describes no less than thirteen species which have used it for food Most of the species are very general feeders, and the list includes such common moths as the buff and white ermines, the garden tiger, lesser yellow underwing and the cabbage moth Excellent half-tone plates illustrate both the caterpillars and the moths bred from them Each species is described in detail, and its host range is given The dot, bright line brown eye, small angle shades, gothic, mouse, bearded chestnut, silver *Y*, and willow beauty moths have all been described, in addition to those mentioned above

Cosmic Ray Bursts and their Variation with Altitude. The bursts of ionisation (Hoffmann *Stösse*) which are produced in a closed chamber, have been studied by C G. Montgomery and D. D. Montgomery (*Phys Rev.*, March 15) at stations the altitude of which lay between sea-level and 4,300 metres The bursts were observed with and without lead above the chamber The rate of occurrence of bursts increases with height much faster than the total intensity of the cosmic rays The frequency distribution of bursts of different size remains approximately constant The authors interpret their results in terms of Swann's theory, according to which the number of non-ionising primary cosmic rays remains constant as they go through the atmosphere, producing bursts *en route* The probability of burst production, however, decreases as the rays pass through the atmosphere On this view the probability of burst production in lead must follow a different law from the burst production in air

Glare from Motor-Car Headlights. The dangers of the dazzle produced by motor-car headlights at night have been well known to every motorist for many years, but no thoroughly satisfactory method of preventing it has yet been devised In a report issued by the Department of Scientific and Industrial Research (Paper No 16, "The Evaluation of Glare from Motor Car Headlights" London H M Stationery Office, 1*s* 6*d* net) it is pointed out that many factors contribute to the problem of glare , it is therefore very difficult to make practical road trials to assess the merits of various devices This report gives a scientific method of analysing the various contributing factors, a knowledge of which is essential before the relative merits can be adjudged of the various devices The term 'glare' is used to denote the driver's power to detect objects ahead of him on the roadway The principal factors involved in determining this power are the candle power in the direction of the observer's eye of the approaching light, the relative positions of the two cars and the object to be detected, their speed and the reflection factor of the road surface The results obtained enable a quantitative study to be made of the conditions of visibility in the cases of a simple headlight using no anti-dazzle device, a dipped and swivelled headlight and a headlight giving a flat-topped beam A factor of primary importance is the threshold difference in brightness between an object and its surroundings Owing to the absorption or scattering of light by the atmosphere, the threshold value depends largely on the presence of mist or fog Unfortunately, this threshold value varies with the previous exposure to light of the observer's eyes. The methods described in this report should enable the existing types of headlight beam to be compared quantitatively, and should aid in the discovery of the best type of beam for universal adoption.

Artificial Radioactivity Produced by Neutron Bombardment. E Fermi and his co-workers have published (*Proc Roy Soc.*, A, April 10) an account of their further experiments on the production of artificial radioactivity by neutron bombardment, of which preliminary accounts have already appeared in Italian. The most interesting result is the enormous increase in the activation of many elements when a quantity of a hydrogen-containing substance such as water or paraffin wax is placed in the neighbourhood of the element and neutron source. Some elements do not show this increase of activation, but it is observed in every case where the product of irradiation is known to be isotopic with the original element. Fermi's explanation of this effect is the slowing down of the neutrons by impacts with hydrogen nuclei. The slow neutrons are very effectively captured by atomic nuclei, giving rise to new radioactive nuclei A number of experiments have been performed to elucidate this effect It is shown that the slow neutrons are strongly absorbed by some elements , the nuclear cross-section of cadmium, for example, reaches the relatively enormous value of 10^{-20} sq cm The capture of the slow neutrons is in some cases accompanied by a γ radiation. Chadwick and Goldhaber have shown (see NATURE of January 12, 1935) that the capture results in the case of boron and lithium in the emission of particles of short range Fermi attempted to find an effect on the activation due to varying the temperature of the hydrogen containing block Such an effect might be expected if the neutrons were slowed down to velocities comparable with thermal velocities No temperature effect was found; but Fermi points out that this result is not quite conclusive about the final velocity of the neutrons [see also this issue of NATURE, pp 903–5]. Experiments have been made on the scattering of the slow neutrons, and they show that once the velocity is reduced to values at which the high efficiency of capture appears, the scattering by hydrogen is also considerable, the mean free path being of the order of a few millimetres in water A small increase in the activation is observed when other elements such as lead, silicon and carbon are used instead of water or paraffin, and the mechanism of production of slow neutrons seems in this case to be obscure The paper contains also some theoretical considerations on the properties of slow neutrons, and a systematic account of the activation of a large number of the elements.

Oxidation of Carbon. A new method discovered in the Northern Coke Research Committee's Laboratory of evaluating metallurgical cokes was outlined in a paper before the Durham University Philosophical Society by Dr H L Riley, the director, on May 10 It is well known that in reactivity to oxygen, charcoal stands at the head, and graphite (or diamond) at the foot of the series of fuels, with low temperature, gas, and metallurgical cokes between Some precision has been given to such determinations by earlier work at the station leading to a quantity known as the 'critical air blast', which is the minimum current of air which will maintain the combustion of a standard coke sample This value is of considerable value in the choice of cokes for the domestic fire In experimenting with wet oxidation methods, it has now been found that determination of the carbon dioxide liberated on oxidation of a graded coke sample by means of a saturated solution of potassium dichromate in syrupy phosphoric acid is a valuable indication of the quality of coke for metallurgical purposes The above order of reactivity is reversed, except that the position of wood charcoal is anomalous (sugar charcoal is unreactive), and also diamond. There appears to be correlation with the proportion of graphite present, retort carbon oxidising readily. It was suggested that the reactivity to oxygen depends on hydrocarbon impurities, whereas these are relatively stable to the wet method, while the latter attacks the long weak valencies (3·4 A) between the layers of graphite in the crystal lattice. Further, the negative chromate ion must be supposed to attack the positive centres, which must be present since graphite is a conductor of electricity like a metal.

The Art of Primitive Peoples

AN exhibition of the art of primitive peoples, which will remain open until the end of July, is now on view at the Burlington Fine Arts Club, 17 Savile Row, London, W 1 It covers a sufficiently wide field to afford an opportunity for comparing and contrasting the ideals and achievement of the æsthetic sense among peoples of a widely differing cultural history and geographical environment, and of estimating how far, if at all, a common element is to be discerned in the development of artistic principles in varied conditions of race, technical skill and material employed as the medium of expression While technique varies considerably in the specimens shown in the present exhibition, it is striking at a first glance how little, relatively, the tools employed, whether of stone, shell or metal, affect the 'polish' of the finished product Hence, while it is true that this collection contains some of the finest known examples of so-called primitive art —it is indeed a possible criticism of the exhibition that it includes so little that is crude, but at the same time scientifically instructive—the general level of execution is higher than might reasonably be expected There are few specimens that fail to attain the highest possible degree of finish of which the artist's intention was susceptible The decorative designs, for example, applied in Polynesia to nearly every object of wood even in daily use, such as the paddle from Austral Islands (No 132) or the Maori tattooed head (No 261), though carved with stone or shell, are often so delicately executed as to have an apparent superficial texture of lacework

The peoples whose art is illustrated in the exhibition are widely distributed geographically Both in number and artistic achievement the exhibits from West Africa hold first place The remainder of the exhibits are drawn mainly from the South Seas, the most important sections being that of New Guinea and the art of the Maoris of New Zealand , but the Solomons, Easter Island, the Sandwich Islands, the Marquesas and other groups are also represented America has been expressly excluded, as an exhibition of American art was held by the Club a few years ago , but there are a few masks and other objects made by the Indians of the North West Coast and a collection of Eskimo ivory carvings One case contains a miscellaneous collection of objects from areas not represented elsewhere in the exhibition. Here some bone needle-holders from Borneo and New Guinea show an incised scroll pattern which, in the use of a south-eastern Asiatic foliate *motif* highly conventionalised, contrasts markedly with other exhibits

In an exhibition of this kind it is difficult to keep the anthropological and the artistic interests nicely balanced, and the rarity or ritual purpose of certain objects may tend to absorb attention to the neglect of artistic merits. Such, indeed, may be the fate of the whole of the collection of objects from the Sepik River, New Guinea, lent by the University Museum of Archæology and Ethnology, Cambridge, among which are the remarkable and unique ceremonial feather-covered boards, of which the longest is 4 ft 9 in long (No 245), and the orator's stool, which is beaten violently while the orator speaks, but is never sat on (No. 33).

An exhibition of 292 items, each of which anthropologically or artistically—and usually on both counts—is a treasure, precludes any attempt at detailed description A bare mention of a few of the more striking specimens must suffice The important exhibit of examples of West African art- statuettes and carvings in wood and ivory and castings in bronze - includes a number of examples of the well-known Benin art. The general character of this group of exhibits will not be entirely unfamiliar to the public, thanks to the recent exhibition of African art Those, however, who know it only from the illustrations which appear in books on African art, can have little conception of the vitality and purpose, which override faults in proportion, according to European standards, when these examples are seen in the round Among the more striking examples here are the Benin flute-player (No 68) and the carved ivory mask from Benin (No 110) , but even more remarkable in its kind is the carved ivory sistrum with beaters, also from Benin There is also a wonderful expression of purpose, which is emphasised by the disproportionately short legs of the figures, in the wooden head-rest supported on two females with arms entwined, from the Congo (No 126) The list of examples deserving prolonged study might even be extended to the whole of this section, if other exhibits did not equally demand attention

Though less spectacular, the small collection of Eskimo ivory carvings is one of the most attractive and arresting features in the exhibition It consists of male and female figures, a mask, a number of toggles, arrow straighteners, amulets and bow-drills. All, but particularly the amulets and toggles in the form of seals, whales and other fauna, display a wonderful realism and appreciation of the niceties of animal forms The gems of this collection, however, are the ivory bows for fire drills (Nos 48–55), which are covered with figures of animals or with hunting and fishing scenes incised in a space which, at most, does not exceed three-quarters of an inch in breadth These pictures, minute as they are, are instinct with vitality, full of action, and almost photographic in their truth to life

The exhibits from the South Seas, and especially the section devoted to the Maori art of New Zealand, includes some choice specimens , some are already well known, while others, such as the War God from Hawaii collected by Capt Cook on his last voyage (No 189), are of historic interest The use of 'mother of pearl' as an inlay, especially in the human figure, is well illustrated in the Solomon Islands group, while of all the representations of the human form in this section, the emaciated figures from Easter Island, with their peculiar facial character, continue to arouse the most interest, and to prompt what is, unfortunately, in the circumstances, a not very profitable ethnological speculation, New Guinea, outside the Sepik River area already mentioned, is well represented in a number of specimens in which the ethnological interest is perhaps greater than the purely artistic. Among these are specimens from Dr. A. C. Haddon's collections from the Torres Straits

The list of objects to which reference should be made is far from exhausted , but enough has been said to indicate the importance of the collection as a whole as a demonstration of the artistic capacity of those backward peoples, to whom few outside the ranks of the student are habituated to conceding recognition in this field of activity.

Report of the Commissioners for the Exhibition of 1851[*]

AMONG the manifold recollections aroused by the Royal Jubilee, it is fitting that we should spare a moment for a backward glance to that May day of eighty-four years ago, when a vast concourse of people from all parts of the world were thrilled by the opening of the Great Exhibition of 1851, and, therewith, a tribute to the potent and beneficent spirit of its creator, the Prince Consort "A complete and beautiful triumph," wrote the Queen in her diary of the opening day, and it became evident in the course of the summer that the venture was to prove a financial triumph Some weeks before the closing day, the Prince excogitated a scheme for the disposal of the surplus, which amounted to £186,000. Its leading ideas, as set out in a memorandum written by him at Osborne on August 10, were the purchase of the Kensington Gore estate and its use for perpetuating the objects of the exhibition, so "that the different industrial pursuits of mankind, arts, and science should not again relapse into a state of comparative isolation from each other"

The publication of the Commissioners' ninth report is well timed The eighth was published in 1911, so that the present report covers almost exactly the period of the reign of H M King George, and it shows how during that period his grandfather's remarkable foresight has had an accumulative influence upon higher education and upon the progress of science and art It expresses the belief that "the Kensington Estate to-day, with its Museums, Libraries, Teaching Institutions and Scientific Societies, fulfils in its range and completeness the aspirations of the Prince"

The policy of the Commissioners since 1911 has been guided by the decision then formed to spend no more money on buildings but to concentrate effort on subsidising youthful talent It was in pursuance of this policy that they established the industrial bursaries, on which they now spend £3,750 a year, or more than a seventh of their income They hoped thereby to bring the universities and their affiliated technical colleges into closer relation with scientific industry through introducing into industrial firms a larger proportion of men with a scientific training and outlook The bursary is intended to make the holder independent of financial assistance from his parents during the period of his training and to remove any restriction upon his choice of occupation or place of abode, with suitable safeguards against the unfair exploitation of the scheme in the immediate pecuniary interests of the employer. In this way more than three hundred well-equipped young students have been helped into industry, and a number of the chief scientific and executive officers in the most important industrial concerns in Great Britain began their careers as bursars of the Royal Commission Already fully 25 per cent of those employed in industry and the public services have been appointed to positions of considerable responsibility, while 13 per cent hold managerial or equivalent rank. Simultaneously "there has manifested itself a clearer appreciation of the benefits to be derived from a more liberal treatment of those in whose ranks are to be found many of our future captains of industry".

Another development since 1911 has been the foundation of a postgraduate scholarship in naval architecture, the need for which had been pointed out by H.M King George when he was president of the Commissioners Practically all the scholars appointed are in permanent positions on the design, research and administrative staffs of industrial firms and Government institutions

Science research scholarships were first instituted by the Commissioners in 1891 under a system which continued in force with excellent results for thirty years, in the course of which they were supplemented by other schemes modelled upon them by various bodies interested in the promotion of science In 1921 it was recognised that the provision made by the Department of Scientific and Industrial Research for scholarships of the same type justified the Commissioners in leaving this field and launching a project whereby a smaller number of awards of much higher value (maximum £450 a year for two or three years) should be made to enable a few experienced research workers in the universities of Great Britain to continue their investigations untrammelled by routine tasks. These are known as senior studentships and they cost £5,250 a year At the same time, the value of the awards to students from the Dominions was increased to £280 and these, the Overseas Scholarships, absorb £6,250 No important university in the Dominions is, the Commissioners observe, without its quota of professors and lecturers who owe their early training in research to these awards, and any additional funds placed at the Commissioners' disposal might advantageously be applied to extending their scope to include the more recently developed countries of the Empire, and in particular India

A census taken some years ago showed that the 560 scholars appointed between 1891 and 1929 had already provided 16 vice-chancellors, principals or deputy principals, 144 professors and many more readers and lecturers on the staffs of universities and colleges, and more than two hundred held positions of the first rank in the public services and scientific industries of the Empire No fewer than forty have already been elected to fellowship of the Royal Society

H M Government has been so impressed by the high value of the Commissioners' educational schemes that it has agreed to release them from further liability, under an offer made by them before the general trend of their policy was changed in the direction already indicated, to contribute £100,000 (of which £35,000 has already been paid) towards the cost of new buildings for the Science Museum, South Kensington

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[*] Ninth Report of The Commissioners for the Exhibition of 1851 Pp. 44. (London: Spottiswoode, Ballantyne and Co, Ltd, 1935)

East Anglian Herring[*]

THE Buckland Lectures for 1933 were given by Dr. W C Hodgson and forecast the publication of researches of great scientific interest relating to the East Anglian herring. They are the result of the team work of the scientific staff of the Ministry of Agriculture and Fisheries, and are quite sufficient in themselves to justify the foresight of the Ministry in the establishment of its laboratory at Lowestoft, in which such team work could be developed.

The working out of year groups in the herring catch, as shown in the rings of the scales, is carried much further and furnishes exact percentages, founded at last on sufficiently large samples The group of each year, estimated on its year of birth, is charted, and the fish are measured, thus giving a complete record of the changes in size of the herrings from year to year There was a rich brood born in 1915, and this richness continued every third year, until there were lapses in 1930 and 1933 A good crop of certain small crustaceans (especially *Calanus*) as food, concentrated in a small area, was found to produce a good fishery, the drift net method of fishing requiring a concentration of fish A plankton indicator, showing the presence of these copepods, in the hands of one experienced master mariner, became a catch indicator, the presence of *Calanus* meaning a trebling of the catch On the other hand, the presence of a flagellate (*Phæocystis*) or of certain diatoms (*Rhizosolenia*, *Biddulphia*, etc) drove away the herrings from the ground, and even altered their line of migration. Thus in 1933 the East Coast drifters had to make long voyages to the north east to find the herrings, and the cause proved to be an enormous belt of phytoplankton across the southern bight of the North Sea, *Rhizosolenia* to the west and *Biddulphia* to the east, both equally distributed from the surface to the bottom of these shallow waters

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[*] The Natural History of the Herring of the Southern North Sea being the Buckland Lectures for 1933. By Dr William C Hodgson Pp 120 (London Edward Arnold and Co., 1934) 3s 6d. net.

Other interesting observations relate to the correlation of the heaviest commercial catches with the periods of full moon, thus obviously not tidal phenomena Between the peaks of the curves are very definite troughs, the difference in the average landings varying from 60 to about 15 crans (see NATURE, 135, 157, Jan 12, 1935)

There is much more, the indication being that the North Sea will be farmed internationally, if human population increases For this the British team is obviously supplying data, while contemporaneously producing scientific results of a class of which the lone research student can never dream At the same time the lack of a market for the herring, our most valuable and cheapest food fish, discourages further research. Here is another team work job, this time for the Food Production Division of the Department of Scientific and Industrial Research, so that the herring may be proffered to the public in a good variety of palatable forms throughout the whole of the calendar year.

University and Educational Intelligence

CAMBRIDGE —The Managers of the Balfour Fund have made a grant of £50 to G J. Kerrich, of Christ's College, for researches on the palæarctic fauna of the north of Finland

The General Board recommends that an assistant directorship of research in physics be established from October 1 in view of the reorganisation of the teaching staff in the Department of Physics at the end of the present academical year.

Graces will be submitted to the Senate recommending the conferment of the degree of M A. (*honoris causa*) on Mr. E A. B Barnard and Dr. W. M Palmer Mr. Barnard is secretary of the Cambridge Antiquarian Society. He has rendered great service to the Corporation of Cambridge by calendaring in collaboration with Dr. Palmer its collection of medieval manuscripts.

Dr. A. C. Haddon's eightieth birthday was marked by the presentation by his friends of a cabinet containing his collection of ethnographical photographs. Dr. Haddon is handing over the collection to the Board of Archæology and Ethnology to make it available for instruction and research.

GLASGOW —Prof Thomas Alty, research professor of physics in the University of Saskatchewan, has been appointed Cargill professor of applied physics. The Cargill chair is the junior chair in the Department of Physics, or Natural Philosophy as it is still termed in the Scottish Universities, and is concerned with the instruction of students proceeding to the various degrees involving applied science such as engineering, applied chemistry, pharmacy, medicine and agriculture Prof Alty received his early training in the University of Liverpool, where he had a distinguished career, and thereafter worked at Cambridge under Sir J. J Thomson While at the Cavendish Laboratory he carried through the admirable research on the cataphoresis of gas bubbles in water which gained him his degree of Ph D His subsequent published work deals with such subjects as the surface structure of liquids, the interchange of molecules and energy between a liquid and its vapour, the electric properties of surfaces and the theory of surface diffusion, while as regards industrial applications of physics he has interested himself especially in the application of electrical methods to the location of underground accumulations of oil, water, metals, rocksalt, etc Prof. Alty takes with him to Glasgow a high reputation as a teacher both in the laboratory and the lecture room

The University Court has now, after long but unavoidable delay, been able to bring into being the Tennent chair of ophthalmology to which it was decided in 1916 to devote a bequest of £25,000 by the late Dr Gavin P Tennent As first holder of the chair, Dr A J Ballantyne has been appointed, after a distinguished tenure of the University lectureship on ophthalmology since 1920

LIVERPOOL —Associate Professor James Rice has been appointed to a readership in theoretical physics Mr Rice was one of the first men in England to grasp the significance of Einstein's principle of relativity and theory of gravitation, and his academic work on this subject was one of the earliest expositions in English He has interested himself in the theoretical aspects of atomic physics and the quantum hypothesis, while his book "Statistical Mechanics" is a standard work dealing with the fundamental theoretical methods by means of which the complex phenomena of the atomic world are rendered amenable to mathematical treatment.

Dr. Norman Feather has been appointed to a lectureship and Leverhulme Foundation fellowship in the Department of Physics as from October next. Dr Feather was a scholar of Trinity College, Cambridge and is at present attached to the Cavendish Laboratory, Cambridge. He is already well-known for investigations on neutrons and related topics in atomic physics.

At a Congregation on May 24 the honorary degree of LL.D was conferred upon the following, among others: Prof. Arthur Harden, formerly director of biochemistry at the Lister Institute, London; Mr C Thurstan Holland, formerly lecturer in radiology, University of Liverpool, president of the first International Congress of Radiology, Dr N. V Sidgwick, president of the Chemical Society, and Prof Alan J. B. Wace, professor of classical archæology, University of Cambridge.

London.—Prof. J. A. S. Ritson, professor of mining in the University of Leeds, has been appointed to the University chair of mining tenable at the Imperial College (Royal School of Mines) from January 1, 1936.

Oxford.—Prof. Julian Huxley has been granted the degree of D.Sc.

Mr. A. J. Ayer has been elected to a research studentship (that is, fellowship) at Christ Church. In addition to problems in formal logic, Mr. Ayer is working on the philosophy of science.

Science News a Century Ago

An Inventor of the Screw Propeller

On June 1, 1835, Thomas Charles Auguste Dallery, one of the inventors of the screw propeller, died at Jouy-en-Josas, near Versailles. Born at Amiens on September 4, 1754, he showed a great aptitude for mechanics, and succeeded to his father's business of an organ builder. Just before the French Revolution, he was commissioned to build an organ worth 400,000 francs for the cathedral of his native city, but the order was cancelled. He afterwards turned his attention to steam navigation, and in 1803 constructed at his own expense a steam-boat driven by a screw or *escargot* as he called it. The vessel was launched on the Seine at Bercy; but, like the attempts of so many other pioneers, Dallery's efforts proved a failure. His patent included several innovations besides the screw, among them being a boiler with vertical tubes. Nine years after his death a commission of the Paris Academy of Sciences, composed of Arago, Dupin, Morin and Poncelet, examined the claims of the Dallery family in regard to his inventions, and reported favourably on them.

South American Deserts

In his "Journal" of his journey northward from Coquimbo to Copiapó, where Capt. FitzRoy had offered to pick him up, Darwin records on June 3, 1835: "Yerba Buena to Carizal. During the first part of the day we crossed a mountainous rocky desert, and afterwards a long deep sandy plain, strewn with broken sea shells. There was very little water, and that little saline; the whole country, from the coast to the Cordillera, is an uninhabited desert. I saw traces only of one living animal in abundance, namely, the shells of a *Bulimus*, which were collected together in extraordinary numbers on the driest spots. In the spring one humble little plant sends out a few leaves, and on these the snails feed. As they are seen only very early in the morning, when the ground is slightly damp with dew, the Guasos believe that they are bred from it. I have observed in other places that extremely dry and sterile districts, where the soil is calcareous, are extraordinarily favourable to land shells".

Earthquakes in Sussex

At a meeting of the Royal Society on June 4, 1835, the secretary, Dr. P. M. Roget, read a "Report of a Committee for collecting Information respecting the Occurrence of, and the more remarkable Phenomena connected with, the Earthquakes lately felt in the Neighbourhood of Chichester", which had been sent to him by J. P. Gruggen. "This paper," said the *Philosophical Magazine*, "contains an authentic report of several shocks of earthquake which, during the last two years, have been felt at Chichester and the surrounding country; drawn up from accounts given by various correspondents, in answer to printed queries extensively circulated. The first shock occurred on the 18th of September and the second on the 13th of November 1833. Another and more severe shock was felt on the 23rd of January 1834, and in the latter end of the same year two slighter shocks were experienced, namely, one on the 27th of August, and the next on the 21st of September; the last, which was less than any of the former, took place on the 12th of January 1835."

The Process of Malting

Among the original contributions to the *Records of General Science* of June 1835 was an article by Prof. Thomas Thomson and Dr. Andrew Steel on the "Chemical Analysis of Gadolinite together with an Examination of some of the Salts of Yttria and Cerium", and another "On Malt", by the editor, Dr. R. D. Thomson. In the course of his article, Dr. Thomson said: "The process of malting consists essentially 1st in producing a change in the constituents of grain by inducing germination; and 2nd in stopping the vegetation when it has been carried to a certain extent by exposure to heat". The subject was one which was exciting some interest at the time and Dr. Thomson added: "A knowledge of the peculiarities of this interesting process is important in a double point of view, because it affords a remarkably beautiful specimen of the chemistry of nature, and because its product forms a staple commodity of British manufacture, no less than forty millions of bushels of malt being annually consumed in the United Kingdom, which at 60*s.* per quarter, exceeds in value the large sum of £24,000,000 and contributes to the Government at 2*s.* 7*d.* per bushel more than £5,000,000 per annum".

Societies and Academies

Dublin

Royal Irish Academy, May 13. **William J. McCallien**: The metaphorphic rocks of Inishowen, Co. Donegal. The nature and distribution of the following subdivisions of the Dalradian rocks of Ireland were described; Malin Head quartzite (oldest), Glengad schists, Linsfort black schists, Stragill calcareous schists, Crana quartzite, Culdaff limestone, Inch Island limestone group, Fahan slates and grits, Inishowen green schists, grits and phyllites. The suggested correlations with the Scottish Dalradians indicate that the first four of these divisions belong to the Islay sequence and that the overlying groups belong to the Lough Awe succession.

Paris

Academy of Sciences, April 15 (*C.R.*, 200, 1373–1444). **Marcel Delépine**: The trichlorides of III iridium-aquo-dipyridine, $Ir(H_2O)Py_2Cl_3$. **Lauge Koch** was elected *Correspondant* for the Section of Geography and Navigation. **Max Serruys**: The extension of the theory of nuclear inflammation to the case of injection motors. **Vincent Nechvile**: The dissymmetry of stellar movements and a method for the determination of the apex of the sun and of the vertex of the ellipsoid of velocities. **Santiago Antunez de Mayolo**: The electromagnetic field and quanta. **Jean Villey**: The classification of energy losses according to the types of irreversibility.

Gaston Dupouy The constitution of paramagnetic bodies. Points of transformation. P. Goldfinger and W. Jeunehomme. The hydration of the D^+ ion in heavy water and the dissociation of the deuteroacids Sergio De Benedetti. The production of positrons in different elements Henri Muller: The lowering of the eutectic point of ice – potassium sulphate Pierre Brun The electrical phenomena accompanying the formation of organo-magnesium compounds The solution of a metal in an alkyl halide, leading to the formation of an organo-metallic compound, is a phenomenon comparable with the solution of a metal in an electrolyte Stéphan Procopiu and D Umanschi. The existence of superficial layers on iron shown by the electromotive force of the metal plunged in water Jean Chédin The Raman effect in mixtures of sulphuric and nitric acids Henri Fournier The variations of mechanical properties observed in an aluminium-magnesium alloy as a function of the refining Mlle Marie Louise Delwaulle: The system bismuth iodide, sodium iodide, water André Boullé The action of water on the anhydrous sodium metaphosphates Osias Binder and Pierre Spacu Contribution to the study of some complex sulphocyanides of iron with pyridine Henri Moureu and Paul Rocquet. The mechanism of the action of liquid ammonia on phosphorus pentachloride The primary product is the pentamide, $P(NH_2)_5$ This has not been isolated but its existence and constitution have been proved. Marcel Frèrejacque The polarimetric determination of mannitol The process is based on the formation of the molybdate acid complex with the resulting increase in rotatory power Paul Cordier Phenylpyruvic acid. the study of its condensation product with benzyl cyanide. Louis Blanchard and Raymond Paul The symmetrical pentanetriol, $OH CH_2 CH(OH) CH_2CH_2(OH)$ André Guillemonat Oxidations of 1 ethyl 1 cyclohexene and 2 methyl 2 butene by selenium dioxide. Marcel Tuot. Some bromine derivatives of the C_8 to C_{11} olefines. Henri Vincienne The extension and the stratigraphic position of banks with Stromatoporoids in the west of the southern Jura, in the neighbourhood of Villereversure. Marcel Geslin· The partition coefficient of radon between the spontaneous gases and the water of the springs Mlles Edna Harde and Annis E Thomson· Vitamin C and alexin Evidence suggesting that alexin may be a compound of ascorbic acid and proteins and perhaps also of lipoids. Jean Régnier and Robert David. The influence of the anion combined with the base cocaine on the anæsthetic activity of this alkaloid The anæsthetic values found range from 0·2 for the citrate to 12 for the phenylacetate, the chlorhydrate being taken as unity. Daniel Gardner and Mlle Maria Luciana Caselli: The biological properties of carvacrol Paul Wintrebert The unity of development and birth of individuality in the physiological epigenesis of Amphibians Fred Vlès and André de Coulon· The appearances of spontaneous cancers in raising mice on the ground, in relation with the differences of cage and earth potential. Raymond Latarjet. The influence of variations of atmospheric ozone on the biological activity of solar radiation. In treatment with sunlight it is not sufficient to base the calculations on hours of exposure. Owing to the variations in solar activity, some kind of physical measurement, such as a photo-electric cell, is necessary. Yervante Manouélian Syphilitic placentas: small forms of the treponeme and syphilitic ultra-virus. Baruch Samuel Levin The purification of lymph with the aid of X-rays The virus used in vaccination against small-pox resists X ray doses many times larger than those killing *Staphylococcus* Experiments are described showing that ordinary lymph can be rendered free from organisms by X-rays in suitable doses without losing its physiological properties. Georges Djian. A method of kinematographic radioscopy

BRUSSELS

Royal Academy (*Bull Classe Sci*, 31, No. 3, March 2, 1935) G Cesàro Some remarks on hyperbolic arcs Elementary relations between hyperbolic and circular functions are discussed. P Stroobant Report on the work of the National Astronomical Committee during 1934 G Bouligand Stability of mathematical propositions The logic of mathematical propositions, definitions of the terms 'stable' and 'unstable' and applications M Winants Hyberbolic equation of the third order with constant coefficients and of category III. solution of Cauchy's problem by the method of successive approximations L Martin On the exchange property of Riemannian functions relative to linear systems of the second order of two independent variables and referred to their characteristics parallel to the axes L Lacremans On a birational transformation of space considered by Caporali H Geiringer A new method of theoretical statistics (problem of two dimensions) (2) H Seligman Report on the work of the National Committee for Geodesy and Geophysics during the years 1931–34 Maria J. Lejeune First trials of a radiographic study of the skeleton of actual Hexacoralla X-ray photographs furnish information on the skeletons of these animals without the necessity of first removing and so destroying the soft parts

VIENNA

Academy of Sciences, March 14 Othmar Ruthner and Julius Zellner Chemistry of the higher fungi (23) *Geaster fimbriatus*, Fr and *Polystictus velutinus*, Pers The first of these contains ergosterol, fatty acids, mannitol, traces of urea, and a polysaccharide, the second contains the magnesium salt of a new, crystalline acid, a cerebrin-like substance, ergosterol, mycose, solid and liquid fatty acids, a tannoid material, glucose, choline and a water-soluble polysaccharide Julius Zellner Chemistry of the lichens (4) *Gyrophora Dillenii*, Mull Arg and *Parmelia furfuracea*, L The first of these, an American lichen, contains ergosterol, carotene-like substances, fatty acids, gyrophoric acid (probably also lecanoric acid), mannitol, glucose, lichenin and another similar polysaccharide From the second, ergosterol, fatty acids, atranorin, physodic acid, resinous materials, erythritol, lichenin and another similar polysaccharide were obtained Willibald Jentschke. Ionisation measurements on separate α-rays By means of the double tube electrometer, which allows of the measurement of the ionisation of separate corpuscular rays, the ionisation per mm of air for polonium and thorium C′ α-particles has been determined. By simultaneous double registration of a single ray, the range and specific ionisation at the relevant point of the path were ascertained independently of one another Raimund Schiedt: Method of counting the α-particles emitted by uranium. The arrangement used is based on the principle of the tube electrometer, and permits of proportional strengthening of the primary ion quantities **Eugen Guth** and **Hermann Mark**: Application of inner-molecular statistics to the properties of long-chain, especially highly polymeric, substances Consideration of the stretch curve and the thermodynamic behaviour of rubber indicates that the extraordinary reversible elasticity of rubber is a consequence of the flexible long chains of which it is composed. The elasticity of aliphatic chain-like compounds, especially long-chain oils, disappears on passing to structures with numerous side-chains, which prevent free rotation, and is lacking also with systems consisting mainly of aromatic components The elasticity of sulphur is also explainable by the presence of chain like molecules, solid crystalline sulphur, on the other hand, consists of ring shaped molecules of the formula S_8

March 21 **Karl Metz** · Choristites from the Carinthian Alps Several species of this sub-genus of the brachiopod family Spirifer from the upper carbonaceous of the Carinthian Alps are described **Raimund Schiedt** The number of α-particles emitted by radium Counts were made with two U_3O_8 preparations of different uranium contents by means of the arrangement recently described **Friedrich Hecht** The uranium contents of the U_3O_8 preparations were determined **Friedrich Hernegger** and **Berta Karlik** The determination of very small amounts of uranium, and the uranium content of sea water A spectrographic method, making use of the fluorescence of uranium in sodium fluoride, was used The water of the Scandinavian coasts contains from $3\ 6 \times 10^{-7}$ to $2{\cdot}3 \times 10^{-6}$ gm uranium per litre **Lambrecht Wissgott** Mass spectrum of the positive rays of radium C′ **Oswald Richter** Induction of the destruction and maintenance of chlorophyll and of assimilation by ultraviolet rays of less than 300mμ from very powerful quartz mercury lamps **Rudolf Inzinger** Geometry of torses **Ernst Peter Pick**. Transference of high and low blood pressures **Armin Dadieu** and **Hans Kopper**. Raman spectra of heavy hydrocyanic acid and heavy hydrogen sulphide The frequency of the C N band falls from 2,094 cm^{-1} in HCN to 1,906 cm^{-1} in DCN, that of the D–C band in DCN remains to be determined D_2S shows a single strong Raman line at 1,875 cm^{-1} **Viktor Pietschmann** A new family of eels from Hawaian waters *Heteromyrus atolli*, nov. gen, nov. spec., is described

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, June 2

British Museum (Natural History), at 3 and 4 30 — M A. Phillips: "British Birds".

Wednesday, June 5

Geological Society, at 5 30 —Prof J S Lee "The Tectonic Pattern of China and its Bearing upon the Problem of Continental Movement"

Thursday, June 6

St. Mary's Hospital, London, at 5.—Sir Henry H. Dale: "The Active Substances in Ergot a Thirty Years' Review" *

Chadwick Public Lecture, at 5 —(at The Chelsea Physic Garden, Swan Walk, S W.3) —Sir E. John Russell: "Modern Changes in Food Production" *

Official Publications Received

GREAT BRITAIN AND IRELAND

The Entrance to Industry a Survey of Points of Contact between Education and Industry in Great Britain, together with Proposals for raising the School Leaving Age and for Part Time Continued Education until 18, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning) Pp 56 (London P E P) 1*s*

The Exit from Industry a Survey of the Provision for Old Age and for Retirement from Gain Occupation in the United Kingdom, together with Proposals for a National Retirement Pensions Scheme, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning) Pp 52 (London P E P) 1*s*

Public Museum, Gloucester Occasional Papers, No 2 Second Catalogue of Potters' Stamps on Terra Sigillata found in Gloucester By Charles Green. Pp 12+1 plate (Gloucester Public Museum) 6*d*

Society for the Preservation of the Fauna of the Empire Occasional Paper No 4 Report on the Vertebrate Fauna of the Owerri Province of Nigeria By I R P Heslop Pp 82+iv (London Society for the Preservation of the Fauna of the Empire) 4*s* 6*d*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1619 (Strut 197) Torsion of a Rectangular Tube with Axial Constraints By D Williams Pp 30+8 plates 1*s* 6*d* net No 1622 (T 3535) Flow in the Boundary Layer of Streamline Bodies By H M Lyon Pp 54+26 plates 3*s* net No 1628 (F M 153 and 'a') Direct Calibration of Compensated Hot-Wire Recording Anemometer By C Salter and W G Raymer Pp 9+7 plates 9*d* net (London H M Stationery Office)

Imperial Institute Annual Report 1934, by the Director, Sir Harry A F Lindsay, to the Board of Governors Pp 56 (London Imperial Institute) 2*s*

Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum Pp ii+34 (London University of London)

OTHER COUNTRIES

Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1934 Pp 15+5 plates (København G E C Gad)

Koninklijk Nederlandsch Meteorologisch Instituut No 106A Ergebnisse Aerologischer Beobachtungen, 22, 1933 Pp iv+40+3 plates 1 50 fl 22A Aerologische Beobachtungen und Terminbeobachtungen in Angmagssalik während des Internationalen Polarjahres 1932–1933 Pp v+19+1 plate 0 70 fl No 108 Seismische Registrierungen in De Bilt, 20, 1932, mit einem Anhang Die Erdbeben in Noordbrabant von 20–28 November 1932. Pp viii+52 0 70 fl ('s Gravenhage Rijksuitgeverij)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87 Descriptions of Middle American Land and Freshwater Mollusca By Henry A Pilsbry Pp 6+1 plate Tertiary Fresh Water Mollusks of the Magdalena Embayment, Colombia By Henry A Pilsbry and Axel A Olsson, with Tertiary Stratigraphy of the Middle Magdalena Valley, by O C Wheeler Pp 7–39+plates 2–5 Description of a New Scorpaenoid Fish (*Neomerinthe hemingwayi*) from off New Jersey By Henry W Fowler Pp 41–43 (Philadelphia Academy of Natural Sciences)

Division of Fish and Game of California Bureau of Commercial Fisheries Fish Bulletin No 43 The Sizes of California Sardines caught by the different Fishing Gear and in the different Localities of the Monterey and San Pedro Regions (Contributions No 113–114 from the California State Fisheries Laboratory) Pp 59 (Terminal Island, Calif California State Fisheries Laboratory)

U S Department of the Interior Office of Education Pamphlet No 59 Legislation concerning Free Textbooks By Ward W Keesecker Pp. 16 (Washington, D C Government Printing Office) 5 cents

Fifty-first Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1933–1934. Pp 8 (Washington, D C Government Printing Office)

U S Department of Agriculture Circular No 332 General Information about the Japanese Beetle in the United States By C H Hadley and I M Hawley Pp 23 (Washington, D C Government Printing Office) 5 cents

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 118 JS-Diagrams for Combustion Gases of Rich Mixture By Keikichi Tanaka and Seiichi Awano Pp. 495–528+11 plates (Tôkyô Kôgyô Tosho Kabushiki Kaisha) 1 35 yen.

The Parliament of the Commonwealth of Australia Eighth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1934 Pp 77 (Canberra Government Printer) 3*s* 4*d*

CATALOGUES

Sotheran's Price Current of Literature No 843 Annotated Catalogue of Works on Mathematics, Astronomy and Physics. Pp 160 (London, Henry Sotheran, Ltd)

Acetylcholine B D H. Pp 8 (London The British Drug Houses, Ltd)

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Encouragement of Discovery and Invention*

A FEW years ago the International Committee of Intellectual Co-operation, "considering that intellectual property was not then sufficiently protected and that scientific property particularly was at that time not protected at all, entrusted a subcommittee consisting of MM Destree, Millikan, Ruffini and de Torres Quevedo with the duty of examining the means by which this protection might be assured" Many schemes for affording protection were examined, among them being one for the establishment of an international bureau , a second, for the creation of a fund contributed to by manufacturers , a third, for the donation of Government funds to the discoverer , and a fourth, for the extension of the patent system to include scientific discoveries No definite scheme for protecting scientific discoveries was, however, adopted, and in consequence the problem of affording protection was afterwards reconsidered by a committee of the American Association for the Advancement of Science After careful consideration of the problem the committee expressed the opinion, first, that the results of research (other than medical research) that have any possible commercial importance or industrial application should be patented , and secondly, that apart from this variation of the means at present adopted for protecting scientific discoveries, no practicable and desirable alternative had been proposed The opinion that the results of research should be patented is apparently being widely followed in Great Britain, if it is permissible to judge from the fifty-second Report of the Comptroller-General of Patents, which has just been published

In a statement on the trend of invention during the year 1934, the Report states, for example, that considerable advance in the field of patented chemical invention has been shown in sensitising dyes used for photographic purposes, due to a closer understanding of the relationship between absorption spectra and chemical composition of the dyes, whereby sensitising action over increasingly diverse parts of the spectrum is obtained Further, although the discovery of the hydrogen isotope, deuterium or diplogen, is at present mainly of academic interest, applications are being received of means for obtaining 'heavy water' and for the production of organic compounds containing 'heavy hydrogen'. Attention is being increasingly directed to sexual and other hormones, and a better knowledge of their chemical constitution has brought appreciably nearer the synthesis of some of these bodies and the manufacture of compounds or derivatives which exhibit to some extent the physiological properties of the hormones

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* Patents, Designs and Trade Marks Fifty-second Report of the Comptroller-General of *Patents*, Designs and Trade Marks, with Appendices for the Year 1934. Pp 24 (London H M. Stationery Office, 1935) 4*d* net

The Report states also that in the electrical arts there have been noteworthy developments in connexion with heavy-current arc rectifiers of the non-mercury type, arc-less switching in high-power switch gear, high-frequency induction coils with compressed powder cores of low permeability, and permeability tuning units in which the magnetic properties of the cores differ according to the positions of the coil and core There has been a continued increase in inventions in connexion with electrical discharges through high vacua or gaseous media as, for example, in X-ray tubes of hitherto unknown proportions working on voltages of the order of half a million In electrical impedance networks for filtering and other purposes, the mathematical technique is being developed in such a manner as to enable problems of increasing generality to be solved by systematic methods The prospect of commercial broadcast television has made cathode ray tubes the focus of much invention, and is leading to the development of amplifiers suitable for handling a wide range of frequencies and to the use of special oscillators for producing deflecting potentials of saw-tooth wave form It will be agreed from these examples in the Report that some scientific men in Great Britain at least appear to be following the advice of the American Association committee to patent those results of research that have any possible commercial importance or industrial application.

The American Association committee also expressed the opinion that, apart from patenting the results of research, no practicable alternative to the very inefficient means at present adopted for protecting scientific discoveries has been proposed As this opinion has been generally accepted, it appears probable that the present inefficient means will perforce continue, and therefore it is advisable that consideration should from time to time be given to the question whether the existing machinery of the rewards for discoveries and inventions can be made to work more efficiently than it has hitherto done. An important part of this machinery is the publication in proper form of discoveries and inventions, because the encouragement of work in those fields, whether it be by honours, professional appointments, patents or otherwise, is very largely dependent ultimately on public acknowledgment of the results The Report brings to mind the different methods of considering and publishing those scientific discoveries that are not patented, and inventions that are, and leads to two suggestions for improving these methods

The first suggestion relates to the form in which scientific papers and specifications of inventions are published The specifications of all patented inventions have undergone examination in the Patent Office by examiners expert in the various subjects and have been accepted by the Comptroller and published in a form that ends with "a clear and succinct statement of claim" of what constitutes the invention Further, the inventions have been classified according to the subject-matter and the classification published, although the Report states that

> "The rise of new arts and the rapid and unpredictable developments in others during the past few years have raised serious and urgent problems in the classification of the subject-matter of specifications Some progress has been made in the solution of these problems, and it is hoped that a revised classification of such matters as the automatic control of machines and apparatus, and the manufacture of synthetic resins and cellulose and its derivatives, will soon be ready for publication."

It might be difficult for our scientific societies to deal in a similar manner with the various papers that they publish, but it would probably simplify their procedure, and it would certainly facilitate classification and future reference, if they were to insist that each paper should contain a clear and succinct statement of what the author claims as his discovery in view of the state of scientific knowledge at the date of publication. The mass of published scientific papers that are insufficiently classified, and contain only vague description, is increasing at such a rate that it seems likely to constitute a mountainous obstacle in the path of future generations of scientific research workers.

The second suggestion relates to the conditions under which scientific papers and specifications of inventions are accepted Scientific societies appear to be more favourably placed for considering papers submitted to them than is the Comptroller-General of Patents for dealing with specifications of inventions, in that societies can refuse any paper on the ground of subject-matter or rather lack of it, while the Comptroller is not, in general, empowered to refuse to accept a specification on the ground of lack of subject-matter of the invention. One result of this limitation of the power of the Comptroller is that there have come into existence many 'paper' patents that are clearly invalid and are a nuisance to the public It would certainly be no harm to the really meritorious inventor, and would probably be greatly in the public interest, if the Comptroller were empowered to refuse to accept a specification on the ground of lack of subject-matter

Reviews

Relativity, Thermodynamics and Cosmology

Relativity, Thermodynamics and Cosmology By Prof Richard C Tolman (International Series of Monographs on Physics) Pp xv+502 (Oxford Clarendon Press, London Oxford University Press, 1934) 30*s* net

THE general theory of relativity has now been before the scientific world for some twenty years, and the special theory considerably longer Fifteen or sixteen years ago, the theory may be said to have definitely superseded Newtonian mechanics in the treatment of macroscopic phenomena, and the whole of physical science, with the partial exception of atomic problems, acquired a new foundation The superstructure, of course, was in the main unaltered, for the new mechanics faded into the old for all but the most fundamental matters, but the basic laws and equations of physics demanded re-statement, and in a few particulars their requirements were at variance with those of classical theory. In these circumstances there was clearly a need for a general statement of the new position, and for more than a decade this need has been satisfied for English-speaking readers by one book—Eddington's well-known "Mathematical Theory of Relativity" There is now a second

Comparison is inevitable, and fortunately can be made without invidiousness In the first place, since Eddington's latest edition differs only slightly from its original, Tolman's book presents the achievements of twelve years' work of which "The Mathematical Theory of Relativity" takes no account. Eddington's treatment of cosmology, for example, is confined to a description, without details, of the now outgrown Einstein and de Sitter universes, while Tolman devotes 150 pages to a comprehensive discussion of all the models of the universe (except that of Milne, which stands outside the applications of general relativity) that have been proposed Much of this section represents his own original work. Again, thermodynamics—which, as an important branch of mechanics, must obviously be re-expressed in relativity terms—is given full treatment by Tolman (whose book, in fact, must now be regarded as the only up-to-date treatment of thermodynamics in existence) but is untouched by Eddington This work is entirely Tolman's own, except for the contributions of collaborators in some of the applications On the other hand, in order to cover so wide a field as Tolman has chosen, some sacrifice of detail has been necessary, and for the mathematical proof of many of the fundamental relations the reader is referred to Eddington Useful appendixes summarise notation, formulæ and constants which frequently occur

The most important difference between the books, however, arises from the difference in outlook of the writers Eddington presents relativity as the spectacle seen from a certain extra-physical point of view Tolman, adhering more closely to the historical development, may be said to describe the journey towards the present position from which Eddington looks back to survey the landscape his culmination is Eddington's origin Thus, while to Eddington special relativity is a particular case of the general theory in which the $g_{\mu\nu}$ happen to be constant, Tolman sees it as a necessary step to general relativity and gives it independent and equal treatment Eddington is preoccupied with the idea, Tolman with the application, Eddington with the philosophical aspect of physics, Tolman with the physical aspect of philosophy

It is a necessary consequence that the books will appeal to minds of different types Those who find themselves responding to and enlightened by Eddington's treatment will tend to classify Tolman's work as a textbook valuable for occasional reference and for enabling one to pass examinations Those, however—and they are many—to whom Eddington is mystical and even unintelligible, will probably find in Tolman precisely what they have been looking for—a clear, accurate, physical account of an important branch of pure and applied science Blessed are they who can appreciate the qualities of both, for theirs is the kingdom of relativity

It is impossible in a brief review to indicate more than the outstanding features of such a book as this. First and foremost, the admirable 'sanity' of the treatment calls for comment. By this we mean that consistently and evidently easily maintained attitude of stability between the Charybdis of unbridled speculation and the Scylla of blinkered restriction to the palpable and tangible, which in these days is so difficult to preserve and so rarely found. The representation of a physical system as a Riemannian manifold is clearly described and its advantages emphasised, but it is never regarded as more (or less) than a very useful device, and in the discussion of both special and general relativity the geometrical treatment is given as an independent account of the phenomena running parallel to the mechanical or analytical account. In the cosmological section, again, it is never "the universe" that is discussed, but "models of the universe", and the relations between such models and astronomical observations are clearly pointed out. One of the most valuable sections of the book, in fact, is that which treats of the wide gap separating the coefficients, $g_{\mu\nu}$, of relativity formulæ from the measurements actually made in the observatory. The connexion, for example, of what we call the "law of nebular recession" with these coefficients on one hand, and with the blackening of a photographic plate on the other, though one of the most difficult and important problems of modern science, is usually slurred over as though it did not exist. Here alone, so far as we know, is an attempt made to deal with it, and though the final treatment probably yet remains to be given, one rises from this book with a greatly clarified view of the nature of the problem.

The writing is clear and unadorned, though never repellent by its austerity. If occasionally we would like a little more elaboration, we are more often thankful that the ideas are expressed so concisely and not obscured by excessive elucidation. No attempt is made to describe the various unified theories that have been proposed with the object of including gravitational and electro-magnetic phenomena in a single scheme of mathematical expression. A wholly satisfactory theory of this type has not yet appeared, and it is probably wise to leave the whole matter outside a book which, however it may have to be modified as knowledge grows, does at least represent a consensus of opinion among those interested in these matters at the present time.

From one point of view, the most important section is that dealing with thermodynamics. This, as has been said, is Tolman's own peculiar field, and although the re-expression of thermodynamics in relativistic terms has at present no practical application outside cosmology, its effect there is sufficiently revolutionary to claim for it much greater attention than it has yet received. For some reason a physical system gains enormously in popular prestige if it is called "the universe", and the prospect of the final running-down of the universe has caused sufficient heart-burning to make a statement of the actual probabilities very desirable. According to relativistic thermodynamics, equilibrium in a gravitational field requires not uniform temperature but a temperature gradient to prevent the flow of heat from regions of higher to those of lower gravitational potential. Reversible processes can take place at a finite rate, and irreversible processes are possible without the attainment of a maximum entropy. Consequently, to use Tolman's very cautious words, "at the very least, it would seem wisest if we no longer dogmatically assert that the principles of thermodynamics necessarily require a universe which was created at a finite time in the past and which is fated for stagnation and death in the future". Disagreement with these results would be intelligible, though they have never been challenged and are accepted by many relativists, including Einstein himself. What is incomprehensible is the neglect, excusably mistakeable for a conspiracy of silence, which has been their lot while the doctrine of the inevitable heat-death of the universe has been preached as an inevitable requirement of modern science.

Mention should be made in conclusion of the excellent printing. There are a few misprints, but we have noticed none that seriously affects the arguments. HERBERT DINGLE.

Primitive Vital Statistics

Primitive Society and its Vital Statistics. By Prof. Ludwik Krzywicki. Pp. xiii+589. (London: Macmillan and Co., Ltd., 1934.) 20s. net.

IN order to form a picture of the state of society at any time or place, some knowledge of the density and the distribution of population is very much to be desired, and may even be said to be almost indispensable. In its absence the picture can have no clear outline. If, in addition, something can be said about marital conditions and about vital statistics (and in particular about the expectation of life), such details are very illuminating. It is a matter for comment that historians and anthropologists seem so often to be unaware of the importance of the matter. It is true that it is only for recent times and for certain peoples that the information is at all complete; but there is much information of some interest, and yet there is a failure to see its importance and to use it. If anyone doubts this, let him examine some history textbooks, and notice how seldom the heading 'population' occurs in the index. For compilers of anthropological textbooks there is the excuse that the information has not been summarised hitherto, and therefore, such as it is, is not easily available But this does not excuse the anthropologists, who have seldom given the matter much attention when in the field, and have never attempted to gather together the facts that are known

It has been left to the professor of social history at the University of Warsaw to perform the latter task. Dr. Krzywicki has worked on the problem for more than thirty years, and now presents us with the results of his researches The efforts of one man, however long pursued, cannot fully cover so enormous a field, but it may be said that, whereas there was formerly no organised knowledge of the population and vital statistics of primitive society, we now have a wealth of data subjected to critical analysis Dr Krzywicki is very fully aware of the defective nature of the material available With the best will in the world it is very difficult for observers in the field to obtain correct statistical data in any quantity about primitive races In fact, as the author points out, observers have seldom been much interested in this side of native life, and in consequence the existing numerical data "have really just got by chance into the pages of books of first-hand information"

The first matter to which the author gives attention is the size of the tribe and the density of population Here, as in regard to the other problems examined, the most extensive data come from Australia and North America He finds that out of some 120 Australian tribes, 70 number less than 500 persons, the average for all the tribes being less than 550 In North America the average size is greater, but out of some 500 tribes more than 300 number less than 1,000 persons. In the rest of America the position is similar. The strict limitation thus placed upon social intercourse is certainly a fact of the first importance in the attempt to understand primitive society and the stagnation which it characteristically exhibits

The author next addresses himself to the dying-out of primitive races after contact with Europeans His explanation is in line with that of other workers on the subject. The death-rate rises owing to the introduction of new diseases , the native scheme of life is destroyed. In consequence, there is little or no object in attempting to rear children who are likely to die, and for whom, if they survive, there is no obvious place. Therefore abortion and infanticide become more prevalent just when they are less needed

The largest part of Dr Krzywicki's work, however, is concerned with the vital statistics of primitive races before contact with Europeans had produced marked results. We are given a great mass of material , it is unlikely that any important additions to it will ever be made, because the search of the literature has been so thorough and the opportunities of getting new information are now so restricted The evidence points to a low fertility and a high infant mortality everywhere among primitive races It is unusual for a woman to bear as many as five children , the common number seems to have been between three and four Only about fifty per cent reach maturity Though Dr Krzywicki finds that infanticide was in some places very prevalent, he does not regard it as a very important factor, for two reasons The children killed were sometimes the weaker , more often they were from a family where there were already young children , therefore in any case the chance of survival was remote Though for the most part the author is concerned with collecting and analysing the facts, he also enters into some interesting discussions as to their implication, as for example, of the importance of the small size of the tribe

A M CARR-SAUNDERS

Life-Histories of Farm Weeds

Prof Dr E Korsmo's Weed Plates Series 1 Plates 1–30, comprising 42 Species of Weeds on Cultivated Soil 84 cm × 64 cm With Descriptive Booklet Pp 78 (Oslo Norsk Hydroelektrisk Kvaelstofaktieselskab Leipzig Koehler und Volckmar A-G und Co , 1934) Paper, 22 gold marks , Leather paper, cloth edges and eyelets, 38 gold marks

PROF KORSMO has conceived and produced the most accurate and detailed exposition that has ever been attempted of many common weeds in all stages of development. With the aid of generous financial support from Norwegian producers of synthetic nitrogen, three series of thirty plates each have been prepared for use as wall diagrams, specifically for teaching purposes The drawings have been made from living plants in natural colours, under Korsmo's personal direction and control, and their detailed accuracy is remarkable. The plates are accompanied by a separate text giving the common names of each weed in a dozen languages, and a general description of its characteristics and habits, together with explanations of the plate figures This text is being published in various languages, as most of the weeds are cosmopolitan in distribution

The illustrations cover a wide field, the aim being to show all the features characteristic of each weed during its life-history To this end, the morphological sketches are frequently supplemented by anatomical drawings, as, for example, in *Chenopodium album*, where a leaf section shows the unusual type of pubescence in this species. In *Taraxacum officinale* the regeneration from mutilated roots under various environmental conditions is demonstrated, together with sections showing the origin of secondary shoots. It is impossible to indicate the wide range of developmental stages covered in these plates, but it is safe to say that all teachers of agriculture and students will find the plates a mine of information, and that experts are the richer by a valuable work of reference. Prof. Korsmo is to be congratulated on the outstanding merit and value of this work and, not least, upon the ability and sympathy of the artists responsible for the drawings.

W. E. B.

Short Notices

The Endless Quest: Three Thousand Years of Science. By F. W. Westaway. Pp. xx + 1080 + 51 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1934.) 21*s*. net.

It is very difficult to review such a book as this—or perhaps we should say "this book", for there can scarcely be another such. Judged by the aim which the title suggests it is, of course, a failure: to deal adequately with 3,000 years of science in a single volume is a sheer impossibility. The impossibility is, in fact, so obvious that such a judgment would clearly be absurd. We can only take the book as an isolated phenomenon and record its effect on a mind freed from preoccupation with ideas of what it should be. When this attitude is adopted, the result is wholly pleasurable. The author talks to us out of a vast store of knowledge in a manner which, subject to a broad classification on a chronological and subject basis, is delightfully informal. Biographical notes, descriptions of scientific institutions, quotations, expositions, criticisms, reflections mix with one another in the most casual way, and it is hard to imagine a more satisfying book into which to dip at those not infrequently occurring intervals which are too brief for systematic work and too long to be wasted. Photographs and diagrams are numerous and excellent; there are questions for the problem-minded and bibliographies for those who wish to pursue the subjects raised; and there is a good index.

Of the two possible viewpoints—those of the present time and of the timeless observer—Mr. Westaway has chosen the former; hence recent work assumes a prominence even greater than that to be expected from its great bulk. From this cause arises what is perhaps the chief defect of the book; it is difficult on any grounds to justify the inclusion, in an account of 3,000 years of science, of the remarks of individual speakers at a Royal Society discussion on heavy hydrogen, for example. But away with criticism: the book is a pleasure to read, and we are grateful to Mr. Westaway for it.

H. D.

Annual Reports on the Progress of Chemistry for 1934. Vol. 31. Pp. 442. (London: Chemical Society, 1935.) 10*s*. 6*d*.

Much fundamental work is summarised in the Chemical Society's Annual Reports for 1934. Mr. R. P. Bell gives an account of the heavy isotope of hydrogen. 'Heavy water', or deuterium oxide, is in fact now an article of commerce, being separated by an electrolytic method. Dr. L. A. Woodward's section on the Raman effect gives a connected account of some of its applications; Dr. N. V. Sidgwick discusses the theory of resonance and the co-ordination of hydrogen, and presents a short statement on heats of formation in homologous series; Mr. E. J. Bowen contributes a review of work in chemical kinetics; Mr. Bell is responsible for sections dealing with electrolytes, kinetic salt effects, and acids and bases; whilst Dr. H. W. Thompson refers to the emission of electrons in chemical change, to certain spectroscopic considerations, to nuclear moments, to the structure of liquids, to optical activity, to valency and the structure of molecules, to supersonic waves, and to optical phenomena and energy transfers. Prof. R. Whytlaw-Gray gives an account of atomic weight work; Dr. W. Wardlaw of metallic carbonyl and nitrosyl compounds, of molecular structures, and of some of the rarer metals; Dr. E. S. Hedges discusses the corrosion of metals. The report on aliphatic organic chemistry is presented by Dr. H. D. K. Drew, Dr. R. S. Morrell, Dr. E. L. Hirst and Dr. S. Peat; Dr. G. A. R. Kon and Dr. T. G. Pearson are responsible for that on the homocyclic division, and Dr. E. E. Turner for that on the heterocyclic division. Analytical chemistry is in the charge of Mr. B. A. Ellis, Dr. J. J. Fox, Dr. S. Glasstone and Mrs. J. W. Matthews. Dr. C. P. Stewart and Mr. A. G. Pollard present an account of advances in biochemistry, whilst Dr. N. Feather discusses radioactivity and subatomic phenomena. These reports are universally valued by chemists and others who wish to keep abreast of modern developments in the subject.

A. A. E.

Chemical Engineering Plant Design. By Prof. Frank C. Vilbrandt. (Chemical Engineering Series.) Pp. x + 341. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net.

Anyone who purchases this book from its title and expects to acquire information on the design of various machines and plant used in chemical works will be disappointed, since the various chapters are devoted to such subjects as location, foundations, drainage, buildings, pumps, piping, and flow diagrams, power and power transmission, and preconstruction cost accounting. The problems considered, therefore, are those associated with the layout and construction of a chemical works and not the design of the individual machines installed therein, although in one chapter entitled "Selection of Process Equipment" brief descriptions are given of the types of machines suitable for specific operations in chemical works

Throughout the book there are copies of questionnaires issued by various firms to enable them to assess the purchaser's requirements before submitting a quotation. There is also a large number of tables giving data upon a wide variety of subjects which would be valuable to anyone planning or constructing a chemical works As the theory underlying any design is not fully discussed, the utility of the book, which might well be entitled "Problems in Planning a Chemical Works", depends upon the data and hints accumulated from practical sources

The English in places is somewhat involved and prevents the reader easily acquiring the information which the author wishes to impart

Introduction to Early Roman Law Comparative Sociological Studies By C W Westrup *The Patriarchal Joint Family* 2 *Joint Family and Family Property* Pp iii + 192 (Copenhagen Levin and Munksgaard, London Oxford University Press, 1934) 12s 6d net

IN this volume—a memorial volume to Sir Henry S Maine—the author reviews two aspects of the family as an institution in the life of early Rome in so far as it is reflected in early law In type it conforms to the pattern of the Indo European joint family It is compared here with the family as it is found in the records of, or in survivals among, the Indo-European peoples, Teutons, Celts, Slavs and Indians

The controlling factor in both family organisation and inheritance of property was first the necessity for ensuring the continuance of the family cult and secondly the desire to preserve property as a group possession. The latter in the mind of the practical Roman was the more important binding force in securing the perpetuation of the family tie, centring in the inheritance by the eldest son as the controlling power in the group, but without the right of absolute possession or disposal The author here examines in detail the modifications of the type which were introduced in Roman practice and traces the course of development in the idea of the family and family property under the influence of various factors, of which in the main the growth of the concepts of the individual family and individual property were the most decisive

Elementary Qualitative Analysis By Dr F. M Brewer Pp viii + 228 (Oxford. Clarendon Press; London: Oxford University Press, 1933.) 6s net.

THERE is a gratifying tendency for modern general text-books on analysis to become something more than collections of tables and recipes by the extension of their scope to include other matter. thus, a text on the quantitative side will deal with the underlying physico-chemical considerations. In the present handy volume, which for the sake of brevity confines itself to the familiar arbitrary common radicles, an attempt is made to emphasise the connexion between the analytical groups and the groups of the Periodic Table, thus combining the general behaviour of an element with its analytical reactions As an example, it is pointed out that, with one exception, those metals which are precipitated by hydrogen sulphide from acid solution occur in Nature predominantly as sulphides; this relationship, which can be extended to other insoluble compounds utilised in qualitative work, has a perfectly simple explanation, and yet is almost universally overlooked

Of the general descriptive matter, little need be said since almost of necessity it must follow the familiar lines; nevertheless, in view of the dual purpose of the book, the volume has a just claim for favourable consideration among the numerous members of its particular class B A E

Encyclopaedia of Veterinary Medicine, Surgery and Obstetrics Edited by Prof George H. Wooldridge (Oxford Medical Publications) Second edition In 2 vols Vol 1 *Veterinary Medicine* Pp xvi + 836 + xlix + 2 plates. Vol 2 *Surgery and Obstetrics* Pp viii + 837–1652 + li + plates 3–6 (London Oxford University Press, 1934) 126s net

THIS encyclopædia, edited by Prof George H Wooldridge, professor of medicine and hygiene at the Royal Veterinary College, London, is written by a panel of forty-eight veterinarians, all recognised authorities in their special subjects Intended to be of use to general practitioners, owners of valuable animals and medical men interested in animal diseases, pathological detail is reduced to the minimum necessary for the understanding of clinical conditions In keeping with the growing importance of the subjects, new chapters on deficiency diseases and endocrinology have been introduced in this, the second, edition The work is comprehensive, authoritative, well illustrated, and arranged on a systematic as opposed to an alphabetical plan A table of contents, author and subject index make reference easy The work will be of real value to all interested in the more practical aspects of animal disease

The Indus Civilization By Dr Ernest Mackay Pp viii + 210 + 16 plates (London Lovat Dickson and Thompson, Ltd, 1935) 6s net

THIS little book is the first of a series of handbooks of sectional archæology, authoritative but not technically advanced, intended for both the general reader and the student Dr Mackay has covered the main outline of the results of the excavation of the prehistoric sites of northern India and the relations, chronological and cultural, of the Indus civilisation adequately and with the lucidity to be expected from his intimate and detailed knowledge He appends a useful bibliography and an excellent series of small but very clear illustrations If the volumes which follow maintain the standard of the first—and they should if the names of the authors who are to contribute may be taken as a guarantee — this series will be a distinct addition to the literature of 'science made popular' in the best sense

The Differential Analyser

By PROF D R HARTREE, F R S, Beyer Professor of Applied Mathematics, University of Manchester

PURPOSE

THE application of mathematics to problems both of pure and applied science often leads to differential equations which have no formal solution in quadratures or in terms of tabulated functions, but for which numerical values of the solutions are required Until recently, the only available methods for evaluating the solutions of such equations were graphical methods, which are rather limited in scope and accuracy, and numerical methods, which are lengthy and require continual concentrated attention on the part of the worker, and rapidly become more laborious the more elaborate the equations So the development of a mechanical method, rapid, accurate, and applicable to a wide range of equations, is an advance of considerable importance, with applications to a wide range of problems of scientific and technical interest

Such an advance has been made by Dr V Bush, of the Massachusetts Institute of Technology, by the development of a machine known as the differential analyser, of which the first was designed and built there[1] The general idea of such a machine in the abstract is due to Lord Kelvin[2], but the practical design of a machine which could be made, and would work accurately when made, is due essentially to Dr Bush

A similar machine, with which the writer has been closely concerned, has been built at the University of Manchester, a short notice of the formal opening of this machine appeared in NATURE recently[3] Another such machine has quite recently been built at the University of Pennsylvania

CONSTRUCTION

The machine consists of a number of units which can be connected to shafts which drive them or are driven by them These shafts can be connected together by gearing in various ways, so that the relations between the rotations of the different shafts satisfy various differential equations. The adaptability of the machine as a whole, which is one of its most important features, depends essentially on the wide range of possibilities of such interconnexions

The essential units are those called integrators, since they carry out mechanically the operation of integration. Each of these is a continuously variable gear, consisting of a friction drive from a horizontal disc, which can rotate about a vertical axis, to a vertical wheel resting on it, the distance from the centre of the disc to the point of contact of the wheel with it can be varied by displacing the disc, the axle of which is carried in bearings in a carriage which can move along a pair of guide bars This displacement of the disc represents the integrand, the rotation of the disc represents the variable of integration, and the rotation of the wheel represents the result of the integration (Fig 1)

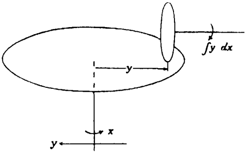

FIG 1 Principle of the integrator

It is essential for accurate operation of the machine that, in the rotational motion of the disc, there should be no slip between disc and wheel at the point of contact On the other hand, it is often necessary to make such connexions that a considerable amount of mechanism is to be driven by the rotation of the wheel, and the friction at the point of contact between disc and wheel is quite insufficient to provide the necessary torque on the shaft To avoid this difficulty, an ingenious mechanical servo-mechanism, called a torque-amplifier, has been developed by Dr Bush for this purpose Its operation is similar in principle to a power-operated capstan A band passes round a drum which is driven by an independent source of power and is continually running; one end of the band is fixed to an arm on the shaft carrying the integrating wheel, and the other to an arm on another shaft (output shaft) coaxial with it The rotation of the integrating wheel tightens the band and therefore increases the friction between it and the drum, and this additional frictional force on the band pulls round the arm attached to the output shaft, so that in effect the rotation of the integrating wheel simply operates as a control of the supply of power to the output shaft As developed by Dr Bush, this control is very delicate, the torque required to operate it being about one ten-thousandth of the torque required to drive the output shaft, and this small torque, can be provided by friction between disc and integrating wheel without any danger of slip

Other units are input tables, used for supplying to the machine information in the form of a functional relation between variables occurring in the equation A graph representing this relation is fixed to a board spanned by a movable bridge carrying a pointer which can be moved along it The position of this pointer along the bridge is controlled by rotation of a handle, which also drives the shaft to which the information expressed by the curve is to be transmitted The bridge is moved across the table by the operation of the machine, and an operator stationed at the table turns the handle to keep the pointer on the curve as the bridge moves

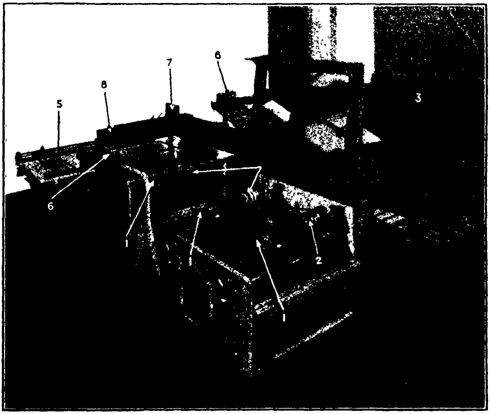

FIG 2 General view of the differential analyser at the University of Manchester 1, Integrators, 2, torque amplifiers, 3, input table, 4, special input table, 5, output table, 6, control switches, 7, revolution counters, 8, base for camera (camera not shown) Photograph by Metropolitan-Vickers Electrical Co, Ltd

There is also an output table, similar in construction to an input table, on which the machine delivers the result in the form of a graph of the solution of the equation For a general survey of the behaviour of the solution, this is the most convenient form of record, but it is not suitable if quantitative results are required, on account of the distortion of paper with changes of temperature, etc., and also on account of the time required to measure up the curves An alternative recorder is a camera which takes photographs, at selected intervals, of a set of revolution counters which can be connected to the appropriate shafts.

In addition, there are differential gears which serve to add or subtract the rotations of two shafts, and 'front-lash units', the object of which is to compensate any backlash in the various drives This is achieved by a gear train arranged to give a small and adjustable angular advance of a driven shaft relative to a driving shaft, at each occasion on which the direction of rotation of the latter changes

The machine is driven by electric motors One motor drives the shaft the rotation of which represents the independent variable, and each pair of integrators has a motor driving their two torque amplifiers, one for each integrator The running of the machine is controlled by a set of switches placed conveniently for an operator who may be following a curve on an input table These switches operate contactors which control the supply of current to the various motors

A general view of the machine at the University of Manchester is shown in Fig. 2, in which the main component units are indicated

OPERATION

The operation of the machine involves two processes . first that of setting up the interconnexions between the units in such a way that the relations between certain shafts satisfy the equation in question; and secondly the carrying out of an actual solution of the equation.

The setting-up is first carried out in diagrammatic form, on paper, and the scales on which the rotations of shafts represent variables in the equation are decided. At this stage, experience counts for a lot, in discovering how to put an equation on the machine, and in deciding between various alternative ways which may be possible. The interconnexions on the machine are then set up from the diagram. The initial conditions for the solution are usually supplied to the machine in the form of initial displacements of integrators.

There are many equations which can be handled without any attention from an operator in the course of the running of the machine, beyond pressing the control switches. Other equations require the use of one or more input tables, for each of which an operator is required as explained above.

The process of setting up the machine may take from half a day to a day, but once it is set up, a solution may be obtained in ten to fifteen minutes, this time being practically independent of the complexity of the equation so long as it is within range of the machine, whereas the process of solution of a comparatively simple equation by purely numerical means would probably take an experienced worker four hours to a day of work which needs continuous careful attention, as, although it is of a routine nature, it is not altogether simple and straightforward; a more elaborate equation, or a less experienced worker, would require much longer.

Use of the machine may thus not lead to a great saving of time when only a single solution of an equation is required, though even then there is considerable saving of mental labour of a routine kind. But when a number of solutions of one equation, for example, solutions with different initial conditions, or different values of numerical coefficients occurring in it, are required, the time occupied in setting up the machine for the equation is a small proportion of the whole period concerned with work on that equation, and the total time required to obtain a specified set of solutions may then be reduced by a factor of 10 or 20. This very large saving of time, and the corresponding saving of mental effort, is important not only in dealing with problems which would in time be dealt with in any case, but even more in making it practicable to undertake extended investigations which without such mechanical assistance would be altogether too laborious and time-consuming.

Further, since the time and labour of mechanical solution does not increase appreciably with the complexity of the equations, whereas the time and labour of numerical solution does increase very considerably, the value of the machine increases rapidly with the complexity and range of equations within its capacity, and this increases rapidly with the number of units of which it is constituted. A machine with eight integrators, for example, is very much more than twice as valuable as one with four integrators.

APPLICATIONS

Since the differential analyser handles a mathematical situation without reference to the particular physical or technical problem which has given rise to that situation, the problem itself is largely irrelevant to it; but some problems to which it can be applied may be mentioned to indicate its range:

(*a*) Atomic structure and properties.

(*b*) Transients in electrical circuits containing elements with non-linear characteristics.

(*c*) Performance of automatic control mechanism.

(*d*) Propagation of radio waves in the Heaviside layer, regarded as a stratified medium.

(*e*) Vibrations of systems with non-linear restoring forces.

(*f*) Paths of electrified particles in the field of a magnet (for example, in connexion with the theory of the aurora and of cosmic radiation).

(*g*) Equilibrium and stability of stellar structures.

By the nature of the case, the differential analyser provides a numerical (or graphical) solution of an equation with definite numerical values of coefficients in the equation, and of initial conditions, and cannot provide a general analytical solution; indeed, one of its virtues is that it can be applied to equations for which no such solution exists. Thus it does not seem likely to be of any great interest or value in purely mathematical fields, in which the interest, if any, in the solution of any equation lies in the general form of the solution, or in its formal analytical expression. On the other hand, in physical and technical investigations, it is often the special solutions, and actual numerical values, which are required; and it may happen that even if there is a formal analytical solution, it is unsuitable for numerical evaluation. So that it is mainly in connexion with such applications that the differential analyser is likely to be used.

THE DIFFERENTIAL ANALYSER AT THE UNIVERSITY OF MANCHESTER

In general design and in many details, the differential analyser at the University of Manchester, which has been constructed by the

Metropolitan-Vickers Electrical Co., Ltd , follows closely Dr Bush's original machine at the Massachusetts Institute of Technology, but several modifications in detail have been made

The machine is being built in two sections, one of which is now complete This completed section comprises four integrators and two input tables, the output table, and a special camera designed and built by Messrs Newman and Guardia, Ltd , for the photographic recorder One of the input tables is of special construction, for handling equations describing the behaviour of a system in which the rate of change of a quantity at time t may depend explicitly on its value, or on the values of other quantities, at time $t - T$ (where the time-lag T may be constant or variable) as well as on their values at time t The second section, now under construction, will comprise four further integrators, making eight altogether, and probably four further input tables, and, as explained above, the greater range will very greatly increase the value of the machine

The construction of this differential analyser has been made possible, first through the great generosity of Mr Robert McDougall, deputy treasurer of the University, who first gave to the University a donation to cover the estimated cost of the first section, now completed, and has recently supplemented this by a further donation to cover the completion of the machine in accordance with the original estimates , secondly, by the friendly and generous co-operation of Dr Bush himself, who freely gave his drawings, and several suggestions for improvement, and helped greatly by his advice based on experience of construction and operation of his own machine , and thirdly, through the co-operation of Mr A P M Fleming, of Metropolitan-Vickers Electrical Co , Ltd , who undertook the construction of the machine, and of those members of the firm who have been concerned in its design, construction and erection

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[1] V Bush, *J Franklin Inst* , Oct 1931, and "Proc Internat Congress on Applied Mechanics", Cambridge, 1934

[2] Sir W Thomson, *Proc Roy Soc* , **24**, 269 , 1876

NATURE, **135**, 535, April 6, 1935

Royal Society Discussion on Supraconductivity

IN opening the Royal Society discussion on supraconductivity, Prof J. C McLennan referred first to new methods of helium liquefaction which have recently been developed In Prof F Simon's method, high pressure helium gas is cooled to liquid hydrogen temperatures and then allowed to expand through a valve, a small quantity of liquid helium being produced which is quite adequate for many types of experiments A second method, developed by Prof P Kapitza at Cambridge, applies to helium the method first used by Claude for the liquefaction of air, part of the gas doing external work in an expansion engine and so cooling the remainder below the inversion temperature of the Joule-Thomson effect, whence it can be liquefied by expansion

Prof. McLennan then discussed the rapid progress in the attainment of temperatures near the absolute zero made possible by the adiabatic demagnetisation method, the latest experiments of de Haas with potassium chromium alum having reached a temperature of 0·0044° on the scale obtained by measuring the magnetisation and using an extrapolated Curie Law to obtain the temperature. Progress is at the same time being made in the establishment of the thermodynamic scale in this temperature region. Prof W. H Keesom reported that the thermodynamic scale has been established down to 0·9° K. using the helium thermometer. Prof Simon reported the results of an ingenious method developed at Oxford in which the heat, dQ, required to warm up the salt from its lowest temperatures to its initial temperature is determined by using γ-rays to warm up the salt Since the entropy change, dS, on magnetisation can be calculated and the cooling is adiabatic, the temperature on the absolute scale is obtained from dQ/dS. The results show that the thermodynamic scale and the magnetic scale using iron ammonium sulphate do not differ by more than 10 per cent down to 0 08° K , but that below this temperature the thermodynamic temperature is greater than the magnetic temperature For these lower temperatures the shape of the specimen has a large effect on the magnetic temperature owing to the increasing importance of the demagnetising coefficient

Prof McLennan referred also to the prediction that at these low temperatures the effect of nuclear magnetic moments should become important, owing to the thermal energy becoming comparable with the energy of magnetisation due to nuclear moments Prof. Simon considers that it may be possible to use a two-stage demagnetisation process for the attainment of the lowest temperatures, the nuclear moments becoming effective in the second stage. Dr. Heitler's prediction in the discussion that it would take a year for equilibrium to be set up owing to the smallness of the nuclear interaction failed to shake Prof. Simon's determination to try the experiment

The production of these low temperatures has extended the list of supraconducting metals, and Prof McLennan gave a list of fifteen such metals with transition temperatures ranging from 0·40° K to 9·2° K As Mr J D Bernal pointed out in the discussion, these metals lie in Groups IVa, Va, VIa and IIb, IIIb, IVb of the Periodic Table, and in no others A number of supraconducting alloys, on the other hand, have been discovered, such as the gold-bismuth series, the components of which lie on either side of these groups and are not themselves supraconducting Mr Bernal considers that supraconductivity has little to do with the crystal lattice, since supraconductors of many crystal types are found Prof Keesom pointed out, however, that one of the varieties of tin is supraconducting whilst the other is not

Prof McLennan referred next to the remarkable phenomenon of the 'Meissner effect' When a metal sphere placed in a weak magnetic field is cooled down to the temperature at which it becomes supraconducting, the lines of magnetic induction move out of the sphere at the transition temperature, and the field outside takes precisely the form which would be expected if $B = 0$ in the interior of the sphere, supraconductivity being thus characterised by the conditions $B = 0$, $E = 0$ When the tangential component of the magnetic field reaches the critical value for supraconductivity, the lines of force re-enter and supraconductivity disappears

Dr Meissner described a number of further experiments on this phenomenon Measurements have been made of the magnetic field in the space round a supraconducting cylinder placed with its axis perpendicular to the field The lines of force in the hollow of the cylinder do not move out, but on the contrary are increased in density when the cylinder becomes supraconducting, and on removal of the external field these lines of induction remain almost unchanged, thus imparting a magnetic moment to the cylinder As the external field is increased, the normal component of the field outside the cylinder increases, showing increasing penetration of the lines of force

Dr K Mendelssohn described experiments on this phenomenon which show that only in the ideal case of a perfectly pure metal and a perfect lattice do all the lines of induction disappear from the supraconducting sphere When the metal is impure, some of the lines of induction appear to be 'frozen in', a rod of moderately pure lead retaining about ten per cent of the flux The results can be explained, he considers, by the formation of annular supraconducting regions in which the flux is 'locked', the formation of such regions being aided by the effect of impurities in increasing the local transition temperature for supraconductivity.

Since a state of zero magnetic induction is equivalent to a diamagnetic susceptibility of $-\frac{1}{4}\pi$, experiments on the force exerted by an inhomogeneous magnetic field on a lead sphere should show an enormous increase in the pull when supraconductivity sets in. An experiment of this type carried out at Cambridge was described by Mr Shoenberg, the force for weak fields corresponding precisely to that expected As the field is increased, the susceptibility remains constant until the field at the equator reaches that critical for supraconductivity At this point, the lines of force begin to penetrate the sphere, and the susceptibility decreases to zero as the main part of the external field reaches the critical value

Considerable discussion took place on the evidence provided by low temperature phenomena on the behaviour of electrons in metals Thus, for supraconducting metals of high purity, the thermal conductivity is increased when the supraconductivity is destroyed by a magnetic field, in agreement with the hypothesis that the supraconducting electrons are an appreciable fraction of the ordinary conduction electrons and that they become available for heat transfer when supraconductivity is destroyed On the other hand, the thermal resistance should tend to zero near absolute zero, whereas the actual resistivity shows a minimum and begins to rise again at the lowest temperatures, one striking case being reported by Prof. Simon in which the thermal resistivity of a copper rod became equal to that of glass at room temperature

Prof Keesom described experiments on the specific heats of metals which show the presence of an additional heat capacity due to the electrons, increasing linearly with temperature in the case of tin up to 9° K. Prof N F Mott considers that additional evidence for the heat capacity due to electrons is provided by the specific heat of metals such as nickel at temperatures of 1000° K, where C_v is greater than the Debye value of $3R$ by at least $1R$, the maximum contribution for electrons being $3/2R$

Further experiments on the effect of electrons in metals were demanded by Prof R de L Kronig, who suggested that the reflecting power of metals should show measurable changes on transition from the supraconducting to the conducting state Changes should also occur in the fine structure of X-ray absorption edges and in the transmission of wireless waves by thin metal films

Prof L. Brillouin and Dr F London discussed the state of the theories of supraconductivity The former emphasised the facts which a theory has to explain, and referred to a proof by Bloch that no classical theory can explain a stable state of persistent currents. Dr. London opened a new attack on the problem by refusing to consider supraconductivity as the limiting case of ordinary conductivity and by considering it as a more elementary state in which the whole metal behaves like a large diamagnetic atom. A new equation, λC curl $J = -H$, relating current density and magnetic field, is postulated, this assumption replacing Ohm's Law in a supraconductor and leading directly to a solution in which stable persistent currents are possible, these currents being confined to a depth of 10^{-5} cm. below the surface of the conductor.

Obituary

PROF. H. M. MACDONALD, O.B.E., F.R.S.

HECTOR MUNRO MACDONALD was born in 1865 at Fearn, Ross-shire, and educated at Tain Academy, Aberdeen Grammar School and the University of Aberdeen, proceeding in 1886 to Clare College, Cambridge, and taking the Mathematical Tripos in 1889. The list of Wranglers was one of considerable distinction: Sir Gilbert Walker was senior, Sir Frank Dyson second, Macdonald fourth and A. S. Ramsey (president of Magdalene) sixth. He was soon elected to a fellowship at Clare, and in 1891 was Smith's Prizeman.

During Macdonald's formative period, the professorial chairs at Cambridge were occupied by Stokes, Adams (the discoverer of Neptune), Cayley, J. J. Thomson and G. Darwin; while of the other teachers, he seems to have owed most to Routh, Hobson, Glazebrook and Larmor. But perhaps his greatest debt was to Verdet's "Leçons d'optique physique", Maxwell's "Electricity and Magnetism" and the works of Horace Lamb and the third Lord Rayleigh.

Macdonald's first published papers were on hydrodynamics and the mathematical theory of electricity—waves in canals, electrical distributions on conductors of various shapes, and self-induction. In 1897, however, he began to write on pure mathematics—the relation between convergent series and asymptotic expansions, the zeros and the addition theorem of Bessel functions, various Bessel integrals, spherical harmonics and Fourier series. In the paper on the zeros of the Bessel functions (*Proc. Lond. Math. Soc.*, **29**; 1898), he gave the result since known as Macdonald's theorem, that the number of zeros of a function $f(z)$ in the region bounded by a contour at each point of which $|f(z)| =$ a constant, exceeds the number of zeros of the derived function $f'(z)$ in the same region by unity, the function $f(z)$ being supposed analytic in the region.

Macdonald's reputation as a discoverer was, however, chiefly due to a third group of researches, which began with his Adams Prize essay of 1902 on electric waves, and was continued in a paper of 1903 on the bending of electric waves round a conducting obstacle, two memoirs on the diffraction of electric waves round obstacles (*Phil. Trans. Roy. Soc.*, 1911–12), several papers on the diffraction of light by opaque prisms, straight edges, etc. (*Proc. Lond. Math. Soc.*, 1913–15), and a series of papers (*Proc. Roy. Soc.*, A) from 1914 onwards on the transmission of electric waves round the earth's surface.

In 1905 Macdonald left Cambridge on being appointed to the chair of mathematics in his old University of Aberdeen. The value of his work was recognised by the fellowship of the Royal Society in 1901, an honorary fellowship of Clare in 1914, a Royal Medal of the Royal Society in 1916, the presidency of the London Mathematical Society in 1916–18, and the Honorary LL.D. of Glasgow in 1934. During the last thirty years of his life, he took an active part in the administrative work of the University of Aberdeen and of educational institutions in the north-east of Scotland, and was almost invariably one of the delegates appointed to any conference of representatives of the four Scottish Universities. In recognition of his scientific eminence and public services, a subscription portrait was presented to the University of Aberdeen in 1933.

Macdonald never married. He died after a short illness on May 16, 1935. E. T. WHITTAKER.

PROF. W. R. HODGKINSON, C.B.E.

ON April 8, at Blackheath, died, at eighty-three years of age, Prof. William Richard Hodgkinson, one of the older school of chemists, whose interests in chemistry covered a wide field. Born at Sheffield in 1851, and educated at the Royal Grammar School there, he early came under the influence of Sorby, the father of metallography, and to this is to be traced his later work on metals and their treatment.

Having gained a scholarship to the Royal School of Chemistry and of Mines in London, Hodgkinson studied geology, and under Sir Edward Frankland organic chemistry, before proceeding to the University of Wurzburg, where his natural feeling for research was stimulated by Prof. Wislicenus, whose textbook on "Organic Chemistry" he translated. On returning to England his investigations at the Royal College of Science were mostly in organic chemistry, and in this branch of chemistry he published papers on such subjects as the action of the alkali metals on organic bodies, with W. H. Perkin, junr., and on organic bases and on naphthalene derivatives, with Dr. W. Limpach, whose sister he married nearly fifty years ago.

After a short period at the Royal Military Academy, Hodgkinson became lecturer in chemistry and metallurgy at the Ordnance College, and later professor of chemistry there, retiring in 1921 after thirty-one years of service in the College (now the Military College of Science). Most of Hodgkinson's work was thus carried out at Woolwich, and much of it was directed to Service problems and to training many generations of gunner officers, who look back to this period of their career with much affection for their teacher, but the feature which impressed itself on all who knew him was the exuberance of his mind in suggesting new investigations. Of such as have been published may be mentioned his researches on the reducing properties of hydrazine and on hydrazine nitrate as an explosive, and on the carburisation of metals by acetylene. He edited and enlarged a textbook of chemistry known throughout many editions to generations of students—Valentin-Hodgkinson's "Qualitative Chemical Analysis".

It will thus be seen that as distinct from modern specialisation, Hodgkinson had an equal interest in and was fruitful in suggestion in organic, inorganic and metallurgical chemistry and became an authority on the chemistry of explosives, writing the Service treatise on that subject. For his work during the War in advising on and directing certain manufactures, he was made a C.B.E. in 1918.

Hodgkinson's personality endeared him to all, and his interests were not confined to his main subject. Thus he was chairman of the Blackheath School of Art and took a live interest in its work, for he himself was a wood carver of great ability. He took part in the local government and in the educational affairs of the neighbourhood of Blackheath, and was founder of the Radium and of the Imperial College Lodges of Freemasonry.

Prof. Hodgkinson leaves a widow, a son (Capt. C. R. Hodgkinson, R.A.) and two daughters, one married to Mr. T. Morson. A much loved son was killed in the War. R. ROBERTSON.

PROF. WILHELM KOLLE

BY the death of Prof. Wilhelm Kolle at sixty-six years of age, on May 10, Germany loses one of her foremost bacteriologists, whose reputation was world-wide. Qualifying in medicine in 1892, Kolle entered the Institute of Infectious Diseases in Berlin in 1893 and became assistant to Robert Koch. By virtue of his position and work in that Institute, he was invited in 1897 by the Cape Government to conduct a scientific expedition in South Africa for the study of leprosy and rinderpest, and in 1900 was sent on a similar mission by the Egyptian Government to the Sudan, where he founded a laboratory at Khartoum. He was afterwards for a time professor of hygiene and bacteriology in the University of Berne, and in 1915 succeeded Paul Ehrlich as director of the Institute for Experimental Therapy in Frankfort-on-Main, where he remained for the rest of his life.

On plague, cholera, leprosy and rinderpest, Kolle made important contributions. He was the first to prepare an effective antiserum for an ultra microscopic virus, that of rinderpest or cattle plague, and the simultaneous method of protection against this disease with virus and immune serum was due to him and to the late Sir George Turner, formerly Medical Officer of Health for the Transvaal. In association with R. Otto, he devised a method of immunisation against plague with attenuated culture of the plague bacillus, and with R. Pfeiffer evolved a method of protection against cholera by means of dead culture. At Frankfort, where he was also director of the Georg Speyer-Haus research institutes, Kolle carried out investigations upon syphilis and spirochætes, and was the first to produce the drug 'neosalvarsan', and also another drug, 'spirocid', the forerunner of stovarsol, which was discarded on account of toxicity.

Kolle's literary activity was prodigious, and he was the author in collaboration with Wassermann of the classical handbook of pathogenic micro-organisms, the last edition of which runs to ten volumes, as well as of a handbook on salvarsan treatment, a textbook of clinical methods of investigation, and one on experimental bacteriology.

R. T. HEWLETT.

PROF. V. POSEJPAL

WITHIN a few weeks of the death of Prof. B. Brauner, Czechoslovak science sustained a second heavy loss. Prof. Václav Posejpal, professor of experimental physics at the Charles University of Prague, died suddenly on April 8. He was born at Chlumec in Moravia on December 20, 1874, and studied at Hradec Kralové before going to Prague and taking his degree in natural sciences in 1900. He selected for his dissertation a thesis on Fourier series. After a period in Paris, studying certain Volta effects on magnetic fields, he returned to Prague, becoming *Privatdocent* at the University in 1910. In 1919 he was installed as professor of physics, and was Dean of the Faculty of Sciences in 1929–30.

Prof. Posejpal was one of the leading Central European research workers in experimental physics, and carried out noteworthy investigations on such subjects as the refractivity of gases at low pressures, fluorescence phenomena, X-ray spectroscopy and resonance. He also contributed to our knowledge of the ether and the neutron. Most of his work appeared in Czech scientific journals, but he also published papers from time to time in the *Comptes rendus* of the Paris Academy of Sciences and in German publications.

Prof. Posejpal was a Chevalier of the Legion of Honour and honorary member of many physical societies. He was general secretary of the Czechoslovak National Research Council and a vice-president of the International Union of Pure and Applied Physics. His colleagues and students held him in high esteem and he will be greatly missed in scientific circles in Czechoslovakia. He was known to a wider public through his popular broadcasts on scientific matters.

Prof. Posejpal was keenly interested in winter sports and frequently conducted parties of friends and students on ski-ing expeditions to the High Tatras and to the Austrian Alps. J. G. F. D.

MR. R. E. RICHARDSON

THE Middle West of the United States lost an outstanding ichthyologist and aquatic biologist by the death on April 14 of R. E. Richardson, best known for his work on the monumental volume, "The Fishes of Illinois", written in collaboration with S A Forbes, and for his researches and publications on the use of organisms as indexes of the degree of pollution of natural waters

Robert Earl Richardson was born at Brighton, Illinois, on November 28, 1877 He was the son of Robert and Emily Dickerson Richardson, members of pioneer families of Macoupin county After preparatory work at De Pauw University, he graduated from the University of Illinois in 1901 He was elected a fellow in zoology there and received the M.A. degree in 1903. He was co-author with David Starr Jordan in a series of papers on the fishes of Formosa, Japan and the Philippines From 1909 until 1922 he had charge of the floating laboratory of the Natural History Survey on the Illinois River. His interests in science were wide and he read widely in other fields—literature, biography, history and finance Owing to delicate and uncertain health, he lived a quiet and secluded life

DAVID H THOMPSON.

News and Views

King's Birthday Honours

THE following names of men of science and others associated with scientific work appear in the list of honours conferred by the King "on the occasion of his Majesty's Birthday, and in commemoration of the completion of the twenty-fifth year of his Majesty's reign". —*O M* Sir Frederick Gowland Hopkins, in recognition of his eminent services to biochemistry, especially in connexion with the discovery of vitamins *Viscount*. Lord Bledisloe, lately Governor-General of New Zealand *G C M G.:* Sir Henry Birchenough, president of the British South Africa Company and chairman of the Beit Trustees *G B E* Sir George Newman, lately chief medical officer, Ministry of Health and Board of Education *K C B* Dr G C Simpson, director of the Meteorological Office *K B E* Prof J C McLennan, professor emeritus and visiting professor of physics, University of Toronto, Dominion of Canada, for fundamental discoveries in physics and scientific services *D.B.E.:* Mrs. M M. Ogilvie Gordon, vice-president of the International Council of Women and former president of the National Council of Women *Knights* Mr N Ashbridge, chief engineer of the British Broadcasting Corporation; Prof. J. Barcroft, professor of physiology, University of Cambridge; Prof A J Hall, emeritus professor of medicine, University of Sheffield, for distinguished service to medicine and medical science, with special reference to problems of the health of industrial workers, Mr J. H M Home, vice-chairman, Advisory Council to Department of Agriculture for Scotland; Dr. L L Fermor, director of the Geological Survey of India; Mr. H H Humphries, city engineer of Birmingham, president of the Town Planning Institute; Mr. P. P. Laidlaw, pathologist to the Medical Research Council, for distinguished service to medical science; Dr. S L Pearce, engineer-in-chief of the London Power Company, Ltd.; Dr. C. L. Woolley, for services to archæology

C.B.: Dr. W. T Calman, keeper of zoology, British Museum (Natural History), president of the Linnean Society of London; Dr. F. S. Sinnatt, director of fuel research, Department of Scientific and Industrial Research; Mr. H. E. Wimperis, director of scientific research, Air Ministry. *C M.G.:* Dr G S. H. Barton, Deputy Minister of Agriculture, Dominion of Canada; Mr. E Harrison, director of agriculture, Tanganyika Territory; Mr E. J. Wortley, director of agriculture, Trinidad *C.I E.:* Lieut.-Colonel B Higham, chemical analyser to the Government of Bombay, Lieut.-Colonel R. Knowles, professor of protozoology and secretary of the Calcutta School of Tropical Medicine *C.B E* Dr. W F Bewley, director of the Experimental and Research Station of the Ministry of Agriculture and Fisheries at Cheshunt; Colonel W. MacC Burden, chief superintendent of the Research Department, Royal Arsenal, Woolwich, Dr C E Cook, chief protector of aborigines, Northern Territory, Commonwealth of Australia; Dr. G W M. Findlay, member of the scientific staff of the Wellcome Research Institution, London, for services in connexion with the study of prevention of yellow fever, Prof. A Fowler, emeritus professor of astrophysics, Imperial College, South Kensington, for services to science, Mr E Marsden, secretary, Department of Scientific and Industrial Research, Dominion of New Zealand; Dr W L. Miller, president of the Royal Society of Canada; Mr. F T. Shutt, lately Dominion Chemist, Dominion of Canada, Dr N. V Sidgwick, reader in chemistry at the University of Oxford, for services to science *I S.O* · Mr W Dallimore, keeper of museums, Royal Botanic Gardens, Kew. *O B E.*. Mr. C E Blaker, principal, Government School of Engineering, Rasul, Punjab; Prof G B. Bryan, professor of physics, Royal Naval College, Greenwich; Mr. G. R King, lately principal of the Gordon Institute of Technology, Geelong, State of Victoria; Mr. H. S Hensman, superintendent, Government Mental Hospital, and lecturer in mental diseases, Medical College, Madras; Dr W. A. Richardson, principal of the Technical College, Derby; Mr A. Walter, director, Meteorological Service, East Africa; Mr H. Wolfe, deputy director of agriculture, Kenya *M.B.E.:* Mrs. N. L. L. Alcock, plant pathologist, Department of Agriculture for Scotland; Mr W Barnicot, secretary of Rothamsted Experimental Station for Agricultural Research; Mr. E O. Sampson, deputy conservator of forests, in charge Dangs Forests and *ex officio* Deputy Political Agent for the Dangs, Bombay; Mr. G. Walton, assistant agriculturist, Northern Rhodesia.

New Foreign Members of the Linnean Society

THE four recently elected foreign members of the Linnean Society are all botanists Dr A F Blakeslee, assistant director in the Department of Genetics at the Carnegie Institution of Washington, is not only an outstanding geneticist but was also the discoverer of the phenomenon of heterothallism in the Mucorineæ, which has had a most profound influence both on the study of fungi and on theories of sex Prof P A Dangeard, until lately professor of botany at the Sorbonne, is known chiefly as a mycologist and cytologist though he has covered a very wide field in botanical research: he has been responsible for *Le Botaniste* since 1889, contributing the whole of many of the volumes Prof G Senn, director of the Botanical Institute at Basle, is a botanist of many sided activities At first mainly interested in algal flagellates, he turned his attention to the physiology of the plant cell, studying particularly the chromatophore More recently he has written a valuable treatise on the botany of Theophrastus He has also worked on alpine plants Prof C Raunkiaer, formerly professor of botany at Copenhagen, has considerably influenced ecological thought by his work on growth forms He has been chiefly interested in phytogeography, morphology, taxonomy and statistical methods His papers have recently been translated into English under the title "The Life Forms of Plants and Statistical Plant Geography".

Dr. Herbert Smith

THE Principal Trustees of the British Museum have appointed Dr George Frederick Herbert Smith to be keeper of mineralogy in the British Museum (Natural History), in succession to Dr L J Spencer, who retires on July 7 next Dr Herbert Smith was born in 1872. He was educated at Winchester, and at New College, Oxford, where he held a Winchester scholarship He took a first in Mathematical Moderations (1892), Final School of Mathematics (1895) and Natural Science School, Physics (1896) He entered the Museum as an assistant in the Department of Mineralogy in 1897, and soon became recognised as an authority on mineralogy and crystallography, and wrote numerous papers on these subjects His book on gem stones has for many years been used as the standard textbook in the jewellery trade He invented the three-circle goniometer, and a hand-refractometer for the determination of gem-stones Dr Herbert Smith's interest in general civil service problems led to his appointment in 1921 to the post of secretary of the Museum, which he has since held He is honorary secretary of the Society for the Promotion of Nature Reserves, and chairman of the Wild Plant Conservation Board

Franklin Institute Medals Awards

SCIENCE SERVICE of Washington, D C, states that the Franklin Institute, Philadelphia, has recently awarded Franklin Medals to Prof. Albert Einstein for his researches on relativity and the photo-electric effect, and to Sir Ambrose Fleming for his work on the thermionic valve A certificate of merit has been awarded to G S Kelley, of New York, for reducing rock dust hazard The following medal awards have also been made for the work indicated Edward Longstreth Medals to Edmund Bruce of the Bell Telephone Laboratories (short wave radio antennæ), Howard D Colman and B A Petersen of Rockford (an automatic spooler); P Davey of New York (a portable balancing device), and K B McEachron of the General Electric Co, Pittsfield (for developing the material thyrite) · John Price Wetherill Medals to Dr F F Lucas of the Bell Telephone Laboratories (photomicroscopy), R E Naumburg of New York (an unusual mechanical apparatus), W H Shortt and F Hope-Jones (precision clocks), Dr J E Shrader of Drexel Institute, Philadelphia (a vibration-measuring instrument); Dr L B Tuckerman of the National Bureau of Standards (an optical strain gauge), H E Warren of Ashland, Mass (the telechron used in electric clocks) Walton Clark Gas Medal to F. J West of Manchester (work *in the gas industry*) Louis Edward Levy Medal to Dr H L Hazen of the Massachusetts Institute of Technology (mechanical robots or servo-mechanisms).

The Quetta Earthquake of May 31

WITHIN little more than sixteen months, the Indian Empire has been visited by another great destructive earthquake. On May 31, at about 2 45 a m (probably about 9.15 p m. on May 30, G M T), the cities of Quetta, Mastung and Kalat were almost entirely razed to the ground In Quetta alone, the loss of life is estimated at more than 20,000 The region is one that has frequently been disturbed by destructive earthquakes. The valuable report by Mr W D West on those of August 25 and 27, 1931, has recently been noticed in NATURE (April 27, p 661) The earlier shock had its centre near Sharigh, which lies 39 miles east of Quetta, the later and stronger near Mach, 26 miles south-east of the same city In the recent earthquake, the epicentral area—if we may take it as lying along the Quetta-Mastung-Kalat line—is roughly parallel to the zone joining Sharigh to the main part of the Mach area, and about 50 miles to the west. It is also parallel to the main structural lines of the country, and especially to the great boundary fault, 45 miles to the west, that runs along the west side of the Khojak Range for a distance of at least 120 miles It was to a nearly horizontal shift of about 2¼ ft along this fault that the severe earthquake of December 20, 1892, was due

Revision of Ordnance Survey Maps

WE are glad to note that the Minister of Agriculture has appointed a committee, under the chairmanship of Mr. J. C. C Davidson, Chancellor of the Duchy of Lancaster, to consider the measures necessary to accelerate the revision of the Ordnance Survey maps The maps in question are the large-scale plans, that is, the 25-in., the 6-in. and, in some cases, even those on larger scales, but chiefly those mentioned The small-scale maps, namely, those on the 1-in and smaller scales, present no problem The large-scale plans, which are numbered by tens of thousands, have been gradually getting very much out of date This is mainly due to two causes: the action of the Geddes Committee of 1922 in recommending further reductions in an already reduced department, and the great alteration in the countryside caused by the expansion of the built-up area and the spread of 'ribbon development' There is also the further difficulty that, simultaneously with the enforced slowing up of revision, there has been an increased demand for the large-scale plans for town planning and for land registration It is clearly high time that the whole matter was examined Many interests are involved, as is indicated by the fact that no fewer than six public departments are represented on the Committee The question is somewhat urgent, and it is to be hoped that the Committee may be able to report speedily, for every month the arrears become more serious There is one curious item in the terms of reference; the Committee is to "review the scales and styles of Ordnance Survey maps placed on sale". It is not to be desired that we should enter again upon the 'battle of the scales' which was happily decided more than two generations ago. Nothing has happened since then to throw doubt upon the wisdom of the choice of the 25 in scale as that of our principal large-scale plans That old 'battle of the scales' lasted from 1840 until 1863, and since the latter date the country has enjoyed, in this matter, the great advantage of an uninterrupted, continuous policy

Civil Aircraft in the Royal Air Force

THE Air Ministry has acquired a De Havilland *Dragon Rapide* and an Avro *Ava*, two well-known commercial types of aircraft, for R.A F. use Such purchases indicate two possible lines of attack on the problem of rapid expansion recently announced. The degree of military usefulness of such machines, and the amount of modification necessary, can be studied in actual experiment by the R A.F personnel concerned. Also the more immediate problem of obtaining a sufficient supply of machines for training and flying practice, for the increased establishment under the new R.A.F. expansion scheme, will be helped, if civil machines are found suitable, and can be built immediately in factories already in production of them. It is understood that the first two of the five new training schools are to be opened this month, each school having the equivalent of three squadrons. Thus the problem of equipment is not only to supply these, but also a progressively increasing number of machines for the use of these pupils as they pass out into the service. It has to be discovered whether it is best to allow constructing firms to accelerate the production of their own aircraft, modified to R.A.F. requirements, or to change them over to contracts to build other machines specifically designed for R.A.F. work. Large contracts have also been placed for the construction of aeroplane hangars in various places.

German Commercial Airship Plans

THE new Zeppelin, Airship *L Z. 129*, is now reported to be complete in skeleton, and work on covering has commenced. It is hoped to launch it at the end of July When completed it will be the largest airship in the world It is 813 ft in length, 135 ft maximum diameter, and has gas capacity of 6,720,000 cubic feet Dr Eckener says that he intends to build three further ships for routes across the North Atlantic, South Atlantic, and to India and Batavia, that will operate under American, German and Dutch control respectively The German operating base will be changed from Friedrichshafen to Frankfort, which is not only more convenient for commercial traffic but is also at a lower altitude The loss of available lift due to starting from the higher altitude of Friedrichshafen is estimated to be about three tons for the *L Z 129*. Arrangements have also been completed for the construction of a mooring mast and gas plant at Seville, in conjunction with the Atlantic routes A new operating company, in which the German Government is said to be interested, is being formed with a capital of about £835,000.

The Admiralty Magnetic Survey Ship

AT the sixteenth annual meeting of the American Geophysical Union, held at Washington on April 26, the following resolution was adopted "WHEREAS, The magnetic survey of the oceanic areas, carried on for 25 years by the Carnegie Institution of Washington, was brought to a sudden end by the destruction of the *Carnegie* at Apia, Western Samoa, November 29, 1929, in the course of a cruise designed to determine the secular change of the Earth's magnetism in all oceans, and WHEREAS, It is of very great importance, not only for the practical needs of the navigator but also for the effective study of the Earth's magnetism, that these observations be resumed at an early day, and WHEREAS, It has been announced that the British Admiralty has decided to build a non-magnetic vessel, designed primarily for securing magnetic data at sea, therefore be it RESOLVED, That the American Geophysical Union is highly gratified at this action of the British Government, assuring, as it does, the continuance of the ocean magnetic work, and expresses the hope that the construction and equipment of the vessel may be pushed to a speedy conclusion, and be it further RESOLVED, That a copy of this resolution be sent to the British Admiralty, to the Astronomer Royal, and to the Chairman of the British National Committee for Geodesy and Geophysics" In transmitting this resolution, Dr Isaiah Bowman, chairman of the National Research Council, writes, "All geophysicists must extend grateful thanks to the British Admiralty in making possible the further accumulation of data so essential to the needs of navigators and of scientific enquiry".

Noise Abatement Exhibition at the Science Museum

ON May 31, the Prime Minister opened the Noise Abatement Exhibition which has been organised by the Anti-Noise League and is being held at the Science Museum, South Kensington, during this month. The opening ceremony was held in the lecture theatre, and was attended by some two hundred guests. The chair was taken by Lord Horder, chairman of the Council of the Anti-Noise League. Mr. MacDonald in his speech opening the exhibition said that formerly a person who confessed that he was troubled by noise was put down as an irreparable crank ; but now it is rightly regarded that noise is something that ought not to be tolerated by any decent man or woman. He suggested that their campaign against nerve jarring should be regarded as a great movement in aestheticism. It is the duty of all to co-ordinate in the protection of life from jars of the eye and the nerves— jars of the complete human personality. Sir Henry Richards, chairman of the Executive Committee of the Anti-Noise League, in moving a vote of thanks to the Prime Minister, said that the League is an educational body and the exhibition is intended to show to the public the means of escape from noise. The Prime Minister made a short tour of the exhibition and inspected among other things a silenced pneumatic road drill, a silenced motor-cycle engine, a ripple tank illustrating the behaviour of sound waves from a speaker in the House of Commons and several models demonstrating the scientific principles of the reduction of noise from machinery and in buildings.

The Health of Sunderland and County Durham

DR. G. F. WALKER, of Sunderland, in a letter to *The Times* last December, made an appeal that the deterioration of health of a section of the population in Sunderland and adjacent districts in County Durham, where unemployment has been severe and prolonged, was serious, and deserved more national consideration. In consequence of statements made in Dr. Walker's letter, the Ministry of Health instituted an inquiry by Dr. Pearse, Ministry of Health, Dr. Glover, Board of Education, and Mr. Grant, Ministry of Health, whose report has now been issued ("Report of an Inquiry into the Effects of Existing Economic Circumstances on the Health of the Community in the County Borough of Sunderland and certain districts of County Durham. London: H.M. Stationery Office, 1935. 9*d.* net). The matter of this report is too lengthy to quote in detail, but is summarised in the concluding paragraph. While admitting that there may be some slight deterioration of health and small increase in the incidence of certain diseases, the investigators state that "We are unable to accept Dr. Walker's statement that there has been in this area a 'substantial and progressive deterioration in public health' ".

Technological Advances of the Past Twenty-five Years

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, spoke on June 3 at a special Jubilee luncheon, held under the auspices of the Society of Engineers, on "Some Significant Technological Achievements of the King's Reign". Sir Frank dealt with four outstanding types of achievement of the period. The first was the advances in medicine which have prolonged our lives ; the second was the more complete harnessing of the electron, an achievement which has given birth to industries unknown in 1910 ; the third was the fixation of nitrogen, an achievement which has overthrown the menace to our food supplies resulting from diminishing quantities of Chile nitrate ; and finally, the production of new steel cutting tools, which has largely affected mechanisation, the price of manufactured goods and the leisure of man. Speaking of the industrial applications arising from the discovery of the electron, and the researches of Sir J. J. Thomson and Lord Rutherford and others on the structure of the atom and on matter in general, Sir Frank said : "When the King came to the throne there was not one listener in the world, for there was no broadcasting station. To-day in this country alone there are over 7 million people with licensed receivers. There are millions of thermionic valves in use, and on his Jubilee day the King spoke via millions of thermionic valves to hundreds of millions of his subjects. The radio engineer was in charge, and by the simple operation of switches, millions and millions of electrons played the parts arranged for them beforehand." The turnover in the radio broadcasting industry, which did not exist twenty-five years ago, was more than 20 millions sterling last year. The harnessing of the electron has been, in Sir Frank's opinion, one of the greatest achievements of the King's reign. It enables one person to speak to and be heard by the whole of the civilised world ; it has increased entertainment and amusement through the 'talkies', and it has enabled our homes, our roads and our public buildings to be illuminated in a manner which many would have thought impossible twenty-five years ago.

British Standards Institution

THE annual meeting of the British Standards Institution was held on May 28, with Dr. E. F. Armstrong in the chair, who, in presenting the report, said the year's work showed marked progress in every section. He laid stress on the fact that more than 150,000 copies of the British Standard Specifications have been sold and distributed during the year, an increase over last year of 23,000, and that there are now 700 committees holding more than 1,000 meetings a year, the total membership exceeding 5,000. The machinery of the B.S.I. is such that no section of industry need fear that its considered views will not receive the fullest consideration, or that a British Standard Specification would be issued in the face of soundly based objection. Moreover, it has been definitely stated that the Institution does not contemplate setting itself up as a testing authority. Mr. W. Reavell, a past-president of the Institution of Mechanical Engineers, has been elected chairman for the ensuing year. He was one of the first to recognise the necessity for the co-ordination of the work of mechanical standardisation, in which the Institution of Mechanical Engineers is taking a leading part. Perhaps one of the most important results of the year's work is the increasing success of the inter-Imperial co-operation which is now so firmly established. Australia has a standards organisation with 500 committees manned by more than 4,500 individuals, and during the past year 75 industrial standards have been issued and 20 more are out for public criticism. British Standard Specifications are good propaganda for British trade, and it is to be noted that more than 12,000 copies have been sent to diplomatic and trade commissioners in all parts of the world, so that they may maintain complete sets which may be consulted by those desiring information regarding British products, as represented by British Standard Specifications. The Government continues its whole-hearted support of the B.S.I. as the national standardising body in Great Britain.

Cider Tasting Day at Long Ashton

THE Open Field Day at the Research Station, Long Ashton, near Bristol, was held on May 2. A large and distinguished company of growers, brewers, men of science and administrators met to exchange views, inspect the laboratories and outdoor plots, and to exercise a discretionary taste upon the samples of cider prepared under controlled conditions by the National Fruit and Cider Institute. Representatives from Canada, South Africa, India, and the United States were present. The function has retained its atmosphere of informality and free intercourse throughout its thirty years, in spite of the fact that visitors have increased in number about a hundred-fold since the first meeting of twenty-five members. The desire to take full advantage of the educational opportunities of the day has also grown. The ciders of 1934 were definitely above the average in quality, but were slightly inferior to the superlative product of the previous year—one cannot expect equal quality from two heavy crops in succession. An exhibit of centrifuging as a method of controlling fermentation attracted much interest, whilst experiments and outdoor demonstrations on pomology, plant nutrition, fruit breeding, economic mycology and entomology, willow culture and fruit and vegetable preservation, were also shown. The Agricultural Advisory Centre, Berkeley Square, Bristol, and the National Mark organisation provided additional exhibits.

Soil Research in Scotland

AT a Scottish joint meeting of the Chemical Society, Institute of Chemistry and Society of Chemical Industry held in Aberdeen on May 17–18, at which Prof. Alexander Findlay presided, the work being carried out at the Macaulay Institute for Soil Research provided the subject for discussion. Dr. Ian M. Robertson read a paper entitled "The Agricultural Utilisation of Peat Land", in which the geology of peat formation, the physical and biological properties of peat and their relation to land reclamation were described. Members of the three Societies had an opportunity to visit the Macaulay Institute for Soil Research on May 18, when the Director, Dr. W. G. Ogg, and his staff, described the particular branches of soil research carried out in Scotland. These included geological work on soils, soil survey work, the investigation of soil fertility, and advisory work among farmers.

South Africa: Progress of Twenty-five Years

THE special South Africa supplement of *The Times*, presented with the issue of May 31, deserves mention for its wealth of interest and its authoritative articles. Published to commemorate the silver jubilee of the Union of South Africa, the supplement reviews the progress of the Dominion during the last twenty five years. Articles on agriculture, mining, migration, education, wild life and native affairs are particularly noteworthy; but other sides of South African life, such as finance, architecture, sport, communications and holiday resorts are not omitted. Altogether, the supplement, which runs to thirty pages and is illustrated with maps and photographs, may be regarded as an important volume' on all aspects of South Africa, and one of permanent value.

Malaria in Ceylon

THE seriousness of the epidemic of malaria that has been raging in Ceylon may be realised from the fact that 74,000 deaths are attributed to this disease during the six months, November–April. Up to the end of April, nearly two million rupees were expended in relief, exclusive of sums for medical treatment. The situation has afforded an opportunity to test on a large scale the value of quinine and of synthetic antimalarial drugs, and the report thereon when published should prove of great value.

British Standard Density Hydrometers

THE Hydrometer Sub-Committee of the British Standards Institution has prepared a draft specification for British standard density hydrometers and tables for use with the hydrometers. The draft specification and tables are now being circulated to interested bodies by the Institution for criticism prior to their final publication. The Institution would welcome comments on the proposals from as wide a circle as possible, and a copy of the draft specification and tables will be forwarded to anyone interested on application to the Director, British Standards Institution, 28 Victoria Street, London, S.W.1.

Nutrition Advisory Committee

THE Minister of Health and the Secretary of State for Scotland have appointed a Nutrition Advisory Committee to "inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition". The members of the Committee are: Lord Luke (chairman), Mrs. Eleanor Barton, Mr. J. N. Beckett, Dr. G. F. Buchan, Prof. E. P. Cathcart, Mr. R. R. Enfield, Dr. J. Alison Glover, Dr. J. M. Hamill, Dr. A. Bradford Hill, Sir F. Gowland Hopkins, Dr. Donald Hunter, Prof. E. Mellanby, Sir John Boyd Orr, Mr. E. C. Ramsbottom, Mr. J. M. Vallance, Mrs. Chalmers Watson, Mr. J. R. Willis, Mr. E. H. T. Wiltshire. The secretaries of the Committee are: Mr. W. J. Peete, of the Ministry of Health, London, S.W.1, to whom all communications on the subject should be addressed; Mr. N. F. McNicoll, of the Department of Health for Scotland;

and Dr. H. E. Magee, of the Ministry of Health (Medical Secretary).

National Baby Week

THE National Baby Week Council, 117 Piccadilly, London, W.1, has issued its report for 1934. The propaganda subject for the year was "The Making of an A 1 Nation", and special propaganda dealt with "The Diet of the Expectant Mother" and "Food and Feeding". National Baby Week is to be held this year on July 1–7, and the special subjects suggested for consideration are "The Welfare of the Pre-School Child" and "Good Nutrition of Mothers and Children". A poster competition is arranged for boys and girls of 'senior schools', and prizes are offered to parents for the best essays on one of two subjects: "What should be done were there an Outbreak of Diphtheria", and "On the Effect of Overcrowding on the Welfare of Mothers and Little Children". The Council will gladly advise and give help on propaganda work, the choice of subjects for lectures, etc., and on other matters relating to infant welfare.

South-Eastern Union of Scientific Societies

THE fortieth Annual Congress of the South-Eastern Union of Scientific Societies will be held at Bournemouth on June 26–29, under the presidency of Prof. A. C. Seward. On June 26, Prof. Seward will deliver his presidential address entitled "The Herbarium of the Rocks". Prof. J. Cameron will deliver a public lecture on June 27 at 8, entitled "Egyptology"; and Lieut.-Colonel C. D. Drew will deliver a public lecture on June 28, at 8, entitled "Recent Excavations at Maiden Castle". The following sectional presidential addresses are announced: Archæological Section (Mr. T. D. Kendrick), "Early Christian Art in the British Isles"; Botanical Section (Prof. H. J. Tabor), "Effects of Certain Physical Factors on the Determination of Plant Habitat"; Zoological Section (Rev. F. C. R. Jourdain), "Zoological Progress during the last Half-Century, with special reference to Ornithology"; Geological Section (Dr. H. D. Thomas), "Some Aspects of Evolution"; Regional Survey Section (Dr. Vaughan Cornish), "Scenic Amenities in Town and Country". Further information can be obtained from the Honorary General Secretary, Mr. Edward A. Martin, 14 High View Close, Norwood, London, S.E.19.

Announcements

AT a meeting on April 27, the Leeuwenhoeck Gold Medal of the Royal Academy of Sciences, Amsterdam, was awarded to Prof. S. N. Winogradsky, foreign associate of the Academy and also a foreign member of the Royal Society, who is director of the Division of Agricultural Microbiology of the Institut Pasteur, Brie-Comte-Robert, France, for his outstanding contributions to the development of soil microbiology. The medal is awarded decennially to commemorate the discovery of micro-organisms by Antony van Leeuwenhoeck. Previous recipients of the medal have been: C. G. Ehrenberg, Ferd. Cohn, L. Pasteur, M. W. Beijerinck, Sir David Bruce and F. d'Hérelle.

DR. WESLEY BOURNE, of Montreal, has been awarded the first Hickman Medal of the Royal Society of Medicine. Dr. Bourne is anæsthetist to the Royal Victoria Hospital, Montreal, and also lecturer in pharmacology in McGill University. He is well known to many anæsthetists in Great Britain, both personally and for his researches into the physiology and pharmacology of anæsthesia.

SIR FREDERICK HOBDAY will deliver the Stephen Paget Memorial Lecture on the occasion of the annual general meeting of the Research Defence Society on June 12 at 3, in the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, taking as his subject "The Relief of Animal Suffering".

THE Walter Rathbone Bacon Travelling Scholarship of the Smithsonian Institution has been awarded to Dr. Richard E. Blackwelder, now engaged in entomological work at the U.S. National Museum, for an intensive study of the staphylinid beetles of the West Indies. Dr. Blackwelder will collect these curious little beetles, which are distinguished from other families of beetles by their short wing covers, although nearly all have normally large wings and most of them are good flyers, on twenty-five West Indian Islands, including Cuba, Hispaniola, Puerto Rico and Jamaica. After completing his collections in the West Indies, Dr. Blackwelder will study the large collections in the British Museum.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Three University lecturers and one demonstrator in the University of Cambridge—Mr. H. Thirkill, Clare College, Cambridge (June 10). A lecturer in mechanical engineering in the West Hartlepool Technical College—The Secretary for Education, Education Offices, West Hartlepool (June 14). A head of the Science Department, Central Polytechnic, Croydon—The Education Officer, Education Office, Katherine Street, Croydon (June 15). A lecturer in physiology in the University of Bristol—The Registrar (June 19). A lecturer in physics and mathematics in the Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (June 21). Geologists on the Geological Survey of Great Britain and the Museum of Practical Geology, Exhibition Road, South Kensington, S.W.7—Director (June 21). A lecturer in physics in the Constantine Technical College—The Director of Education, Education Offices, Middlesborough (June 22). A head of the Chemistry Department in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (June 22). An assistant lecturer in agricultural botany in the South-Eastern Agricultural College, Wye, Kent—The Secretary (June 22). A temporary lecturer in geography in Armstrong College, Newcastle-upon-Tyne—The Registrar (June 25). Two research workers at the research laboratory of the Freshwater Biological Association of the British Empire, Wray Castle, Ambleside, Westmorland—The Naturalist-in-Charge (July 1).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 962.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Echo Sounding in Fishery Research

THE vessel used for the annual oceanographical investigations in the Lofoten area (the *Johan Hjort*) had a Hughes echo sounding gear (magnetostriction system, frequency 16,000 cycles per second) installed before leaving Bergen last February. The gear worked smoothly all along the coast and besides furnishing a great number of interesting sections, revealed many features hitherto unsuspected; among others, that the clay flooring of deep fjords is invariably about 10 m thick and generally very flat.

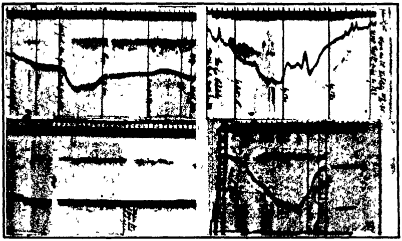

FIG 1 Four 'echo'-records showing spawning cod in midwater at Lofoten The left-hand diagrams partly with ship stopped The bottom right-hand record is somewhat disfigured by oscillations set up by excessive shaking of ship's motor but it shows also a second echo from the bottom, reflected from the surface Marks on top of each diagram are produced every minute and are 6 7 mm apart

Marks referable to fish were seen on the record only after the arrival at that portion of the Lofoten fishing area where the most prolific fishing has been going on during recent years—at Høla—a bight of the West Fjord of very restricted dimensions, say, 10 miles by 4 miles. At this place fish were indicated continuously along straight courses of 2 nautical miles and more The nature of the indications may be seen from Fig. 1, which is a photographic reproduction of four separate records, partly obtained while the ship was stationary among the hand-line boats, which got the fish exactly at the depth indicated.

It is interesting to note that this spawning concentration of cod has apparently no relation to the bottom. This was well known before, but no one could have imagined the fish to be limited to such a sharply defined layer of only 10–12 metres in thickness, extending widely above deep water and shallow, always at the same distance from the water surface. This distance was 72 metres at the first encounter with the spawning shoals (March 11) and 50 metres at the conclusion of this investigation on April 5 Concurrently, the temperature in the 'fish' water-layer had decreased from 6 5°–6·0° to about 3·0° C. In some instances a perceptibly lower oxygen and hydrogen ion concentration was observed in this water-layer than in the layers immediately above and below.

Although two zigzag trips were made across the entire bank area of the West Fjord, strong marks such as those shown in the records reproduced were only obtained at the locality referred to above; in other places only small and widely separated dots. Still a certain amount of fishing, if not very successful, was going on everywhere A true estimate of the quantity of fish represented by marks of different types can, however, be gained only by further study in connexion with the use of suitable fishing implements

OSCAR SUND.

Johan Hjort,
Kabelvåg, Lofoten
April 6

Absorbing Layer of the Ionosphere at Low Height

THE ionosphere is now generally regarded as divided into two main regions of intense ionisation The upper (*F* or Appleton) region commences at a height of about 250 km, while the lower (*E* or Kennelly-Heaviside) region begins at a height of about 90 km. Besides these two main regions, the existence of a so called *D* or absorbing layer has been suggested from time to time[1] The presence of such a layer has not, however, until now been experimentally demonstrated, and it has rather been the tendency in recent years to discredit its existence Recently we have, however, in the course of our ionospheric studies at Calcutta been able to detect echoes of radio waves returned from a virtual height of about 55 km. by the well-known pulse method. The echoes from the *E* layer were at the same time observed to be returned from a virtual height of 119 km The present communication gives a preliminary account of the observations we have made in connexion with the existence of a low-lying absorbing layer.

The appearance of echoes from the *D* layer is closely connected with the weakening of echoes from the *E* layer which is observed with the progress of the day[2]. This absorption may be due either to a decrease in the gradient and lowering of the height of the lower boundary of the *E* layer, or to the formation of a distinct absorbing layer at a much lower level. Against the first hypothesis, both observations and calculations show that the lower boundary of the E layer must be extremely sharp[1] From such a boundary all frequencies below the critical penetration frequency will be copiously reflected, while all those above will penetrate the boundary Observations made by us, however, show that during daytime there is a frequency band above and below the limits of which no reflection is obtained from the E layer The limits of the frequency band vary with the hour of the day Fig 1 depicts typical limits on a summer day at Calcutta

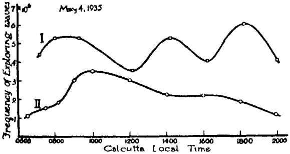

FIG 1 Curve I gives the penetration frequencies of the E layer for various hours of the day Curve II gives the frequencies for which echoes from the E layer first appear from the side of long waves The vertical distance between the two curves for any hour of the day gives the range of frequency for which echoes are obtained from the E layer only

The hypothesis of a diffuse D layer at low height, where collision frequency is very great, offers an easy explanation of these phenomena This layer will absorb long waves strongly, preventing their reflection due to the diffuse boundary, and will only allow waves of lengths below a certain limit to penetrate it These latter waves will either be reflected from or will penetrate the E layer In short, the E layer with its sharp boundary will reflect all frequencies below a certain limit and the D layer with its diffuse boundary absorb all frequencies below another lower limit The sharp boundary of the E layer cannot cause the disappearance of frequencies lower than the critical penetration frequency as shown in Fig. 1 The hypothesis of a diffuse E layer boundary causing absorption is untenable because the virtual height of the E layer as measured by us for a number of frequencies in the frequency band of Fig. 1 has been found to be practically constant.

On very rare occasions when the lower boundary of the D layer becomes extremely sharp, it is able to reflect waves. Such were the occasions on April 2, 3 and 5 between the hours 15 00 and 17 00, when we were able to detect the echoes as reported in the beginning of the note.

There are other arguments in favour of the existence of the D region Without the intervention of such a region, the virtual height of the E layer ought to rise gradually with the setting of the sun Observations show, however, that the height has a tendency to decrease with the close of the day This is easily explained as due to the disappearance of the D layer, which by its presence during the day increases the virtual path of the wave Again, Fig 1 shows that Curve I, which is a graph of the penetration frequencies of the E layer, has pronounced hourly variations. This feature of the curve is present almost every day during this part of the year. Curve II, which is a graph of the frequencies for which echoes begin to appear from the E layer, has no such pronounced hourly variations, but gradually rises and falls with the progress of the day. There being scarcely any correlation between the two curves, it follows that the agency responsible for Curve I must be different from that for Curve II This other agency, according to our hypothesis, is the absorbing layer at a virtual height of 55 km

It is noteworthy that the region where the absorbing layer has been detected by us, is also, according to many authorities, the region of the ozonosphere[4] It is not unlikely that the ionisation in this region is connected with the formation of ozone, as suggested by Chapman[5]

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May 6

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[1] Appleton and Ratcliffe, *Proc Roy Soc*, A, **128**, 155, 1930 M A Bontch Bruewitch, *Proc I R E*, **22**, 1135, 1934 S Sillitoe, *Canad J Res*, **11**, 163, 1934.

[2] F W G White, *Proc Phys Soc*, **46**, 101, 1934.

[3] Appleton and Naismith, *Proc Roy Soc*, A, **137**, **39**, 1932 (Fig 1) Mary Taylor, *Proc Phys Soc*, **46**, 415, 1934 D. F. Martyn, *Proc Phys Soc*, **47**, 335, 338, 1935

[4] G M B Dobson and D N Harrison, *Proc Roy Soc*, A, **114**, 537, 540, 1927 Chapman, *Proc Roy Soc*, A, **132**, 356, 1931

[5] Chapman, *Quart J Roy Met Soc*, **52**, 231, 1926.

Propagation of Radio Waves over a Plane Earth

THE purpose of this letter is to point out an error in sign in Prof A. Sommerfeld's original paper (1909) on the attenuation of radio waves[1] This error in sign has recently been reflected in Bruno Rolf's graphs[2] of the Sommerfeld formula, predicting dips to zero in the field intensity at finite distances from a radio transmitter and other anomalous phenomena. This error in sign has been corrected in Prof Sommerfeld's 1926 papers[3] and also does not occur in the derivation by B van der Pol and K F Niessen[4]. In this latter paper an exact expression is given for the potential of a vertical infinitesimal dipole (equation 21) After expanding this expression, I found that most of the terms are negligibly small at moderately low frequencies for distances from the source greater than a wave-length, giving for the potential function of a vertical dipole over a plane earth :

$$\Pi(r, 0) = \frac{e^{ik_1 r}}{r}\left[1 - 2\sqrt{p}\, e^{-p}\int_{i\infty}^{\sqrt{p}} e^{w^2} dw\right]$$

$$\text{where } p = ik_1 r\left[1 - \left\{1 + \left(\frac{k_1}{k_2}\right)^2\right\}^{-1/2}\right] \equiv p_0 e^{ib} \quad (1)$$

$$\text{and } k_1 = \frac{2\pi}{\lambda}, \text{ and } k_2^2 = k_1^2\,(\varepsilon + i2c\lambda\sigma),$$

where ε is the dielectric constant of the ground referred to air as unity, σ is the conductivity of the ground in electromagnetic units, c is the velocity of light in cm. per sec., λ is the wave-length in cm. and r is the distance in cm.

In the above equation, p is the 'numerical distance' as defined by van der Pol and Niessen and is slightly different for high-frequencies from the 'numerical distance' used by Sommerfeld ; this difference makes the above formula accurate for large values of the parameter b and free from the errors which Rolf[5] made by using the Sommerfeld 'numerical distance'

Rolf used equation (1) with the lower sign reversed on the integral for computing the field intensity from a distant radio transmitter Correcting this error in sign, I have found that the following empirical formula for the field intensity may be determined from equation (1)

$$F = \frac{c}{r} \sqrt{P} \left[f(p_0) - \sin b \sqrt{\frac{p_0}{2}}\, e^{-\frac{5}{8} p_0} \right] \ldots\ldots (2)$$

This formula gives the field intensity, F, in microvolts per metre when the radiated power from the transmitter is P kilowatts and is applicable for $b < 30°$, that is, for frequencies less than about 10,000 kc /s for transmission over ground of average conductivity about 10^{-13} E M U. The quantity in the square brackets is the 'attenuation factor' and reduces to $f(p_0)$ in the case $|k_2^2| >> k_1^2$. This was the case discussed by Sommerfeld, and values for $f(p_0)$ are given by Rolf in his first paper--van der Pol[6] also gives the following empirical formula for $f(p_0)$ ·

$$f(p_0) = \frac{2 + 0\ 3p_0}{2 + p_0 + 0\ 6p_0^2} \quad \ldots \quad (3)$$

Formula (2) is limited in this application to a plane earth, the actual ground wave field intensity being influenced by the curvature of the earth at the greater distances, this effect being the predominating influence at sufficiently low frequencies

K A NORTON

Federal Communications Commission,
Washington, D C
March 8.

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[1] *Ann Phys.*, **28**, 665, 1909

[2] Ingeniors Vetenskaps Akademiens, Handlingar No 96, 1929 *Proc I.R.E*, **18**, 391, 1930

[3] *Ann Phys*, **81**, 1135, 1926

[4] *Ann Phys*, **6**, 274, 1930

[5] See criticism by W H Wise, *Proc I R E*, **18**, 1971, 1930

[6] "Jahrbuch der Drahtlosen Tel und Tel", **37**, 152, 1931

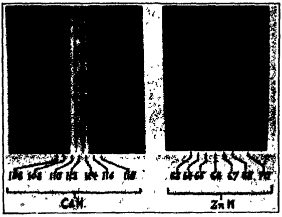
Band Spectroscopic Observations of the Isotopes of Zinc and Cadmium

ACCORDING to earlier mass-spectroscopic investigations by Aston[1], cadmium has the following isotopes arranged in order of their abundances . 114, 112, 110, 111, 113, 116. Later, two additional isotopes, 108 and 118, were observed by one of us[2], as a result of an investigation of the band spectrum of cadmium hydride.

Recently, Aston[3] has reported the discovery of three new cadmium isotopes, 106, 108, 115, but no evidence of the existence of Cd^{118} was obtained. As Cd^{118} appeared to be more intense than Cd^{106}, and the former isotope had not been mentioned by Svensson, Aston concludes that these results are not reliable; in particular, that the existence of Cd^{118} must be considered as rather dubious.

Our spectrograms, on which the above mentioned observations were based, did really give indications of lines corresponding to Cd^{106}, but were not published because of their spurious appearance as compared to the lines of $Cd^{108,118}$ which were present in some thousands of groups in the spectrum. As may be seen from Fig. 1 (*a*) representing the group at λ 4728 A and corresponding to $R_2(18\frac{1}{2})$ in ($v' = 0$; $v'' = 3$) of the $^2\Sigma \rightarrow {}^2\Sigma$ transition, Cd^{106} is present, although having decidedly less intensity than $Cd^{108,118}$. This intensity relation seems to hold throughout the observed spectrum The existence of odd isotopes in cadmium could not be verified[2] on account of insufficient separation of the even components in a group.

The isotopes of zinc have also been the subject of several investigations, contradictory results having been obtained Thus according to Aston[4], the following isotopes are present 64, 65, 66, 67, 68, 69, 70 Bainbridge[5], however, was unable to observe $Zn^{65,69}$. From an unpublished investigation on the band spectrum of zinc hydride, one of us (G. S) observed the following isotopes 64, 66, 68, 67, 65, 63, 70, their abundances being in the order in which the numbers are given Thus agreement is found with the results of Aston regarding Zn^{65} (not observed by Bainbridge) and vice versa regarding Zn^{69} Our new isotope Zn^{63} is clearly visible in Fig 1 (*b*), representing the group at λ 4035 0 A and corresponding to $R_1(33\frac{1}{2})$ in ($v' = 0$, $v'' = 0$) of the $^2\Pi_{3/2} \rightarrow {}^2\Sigma$ transition The line corresponding to Zn^{63} is far more intense than that of Zn^{70}, which is too faint to appear on the reproduction, although clearly visible on the original plates



(*a*) (*b*)

FIG 1

Our statements regarding the isotopes of zinc and cadmium are based on observations of extensive regions in the spectra of their hydrides. Some thousands of line groups have been measured in each spectrum, the isotope separations being in perfect agreement with the theory of isotope effects in band spectra. We would suggest, therefore, that the disagreement between band spectroscopic and mass-spectroscopic observations regarding the existence of isotopes does not indicate the unreliability of the former method but must be explained in some other way.

GÖSTA STENVINKEL.
ERIK SVENSSON.

Laboratory of Physics,
University, Stockholm.
March 20.

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[1] F. W Aston, "Mass-spectra and Isotopes", 1933, *p* 120

[2] Erik Svensson, NATURE, **131**, 28, 1933

[3] F W. Aston, NATURE, **134**, 178, 1934

[4] F. W. Aston, "Mass-spectra and Isotopes", 1933, p 118.

[5] K. T. Bainbridge, *Phys. Rev*, **39**, 487, 1932

Raman Spectrum of Deuterobenzene

WE have photographed the Raman spectra of the various deuterobenzenes. In order to obtain the isotopic shifts of the Raman frequencies with a fair accuracy, the spectra were investigated with high dispersion, which necessitates a rather large volume of the substance, the Raman tube employed contained 18 c.c. For the preparation of deuterobenzene we have investigated various possible exchange reactions and have finally chosen the Friedel Craft reaction

$$C_6H_6 + 6DCl \underset{AlCl_3}{\rightleftarrows} C_6D_6 + 6HCl.$$

This process has the advantage of high reaction velocity, and further, our experiments indicate an appreciable shift of the equilibrium towards the deuterobenzene. Details concerning this reaction as well as the common physical properties of the deuterobenzene will appear elsewhere. Of course this method produces a mixture of the various deuterosubstituted benzenes in proportions very nearly corresponding to the probability distribution. By photographing the spectra of deuterobenzenes with various contents of deuterium, it is consequently possible to identify the Raman lines belonging to each deuterobenzene.

We have measured the complete Raman spectra of the molecules C_6H_5D, C_6D_5H and C_6D_6. All the Raman frequencies of benzene are found to be lowered by introduction of deuterium in the molecule.

Fig 1 is an enlargement of a part of two Raman plates and shows the isotopic shift of the strongest line of the spectrum, namely, the frequency corresponding to the symmetrical ring vibration. The plates show distinctly greater isotopic shift between C_6H_6 and C_6H_5D than between C_6D_5H and C_6D_6, owing to the comparatively greater alteration in mass in the first case. The Raman frequencies are respectively 992·6, 981·5, 952·4 and 946·6 cm.$^{-1}$.

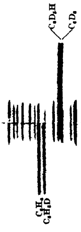

FIG 1

The Raman frequencies of C_6D_6, together with those of C_6H_6, are as follows:

Raman Frequencies (cm^{-1})

C_6H_6 606·4, 849·7, 992·6, 1175·6, 1585·9, 1604·2, 3048·3, 3061·5

C_6D_6 581·6, 844·7, 946·6, 869·8, 1555·4, 1569·0, 2266·8, 2292·0.

It is interesting to note the great shift of the 1175·6 line in benzene (to 869·8 cm.$^{-1}$ in C_6D_6), which shows that this frequency, as well as the 3048·3 and the 3061·5 frequencies, belongs to a pronounced hydrogen vibration.

The spectra of C_6H_5D and C_6D_5H are much more complicated owing to the split up of the degeneracy of certain vibrations in the symmetrical molecules C_6H_6 and C_6D_6, and are of great interest for the identification of these. A detailed report of the investigation and a discussion of the results will appear shortly elsewhere.

A. KLIT.
A LANGSETH

Universitetets kemiske Laboratorium,
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May 3

Spontaneous Emission of Neutrons by Radio-elements

I CURIE, Joliot and Preiswerk[1] have shown that by bombarding silicon and phosphorus by neutrons there are produced radio-elements which spontaneously emit neutrons, in addition to electrons (Fermi effect), positrons and γ-rays. Thus an entirely new type of radioactivity has been discovered by them.

The mechanism of the spontaneous ejection of neutrons is not fully understood. At any rate, it may be supposed that this process is a secondary one, as the experiments on the Fermi effect have shown clearly enough that the potential energy of the neutron in the nuclear field is negative (the barrier is absent), and hence the neutron, having received somehow or other some positive energy, must leave the nucleus immediately or pass into a state of negative energy, exciting another particle or emitting γ-quanta.

In their communication, I Curie, Joliot and Preiswerk explain the emission of the neutrons by the following processes

$$(1)\ {}_{13}Al^{28} \rightarrow {}_{13}Al^{27} + {}_0n^1 \text{ and } (2)\ {}_{14}Si^{31} \rightarrow {}_{14}Si^{30} + {}_0n^1$$

Such an interpretation (primary process) cannot be admitted *according to the considerations mentioned above*, moreover, it would seem impossible energetically, although we cannot assert this definitely because the accurate values of the masses of all the components of reactions 1 and 2 are not known.

I have attempted to find the energy distribution of the spontaneously ejected neutrons or at least to estimate its upper limit. For the detection of the neutrons I used a photographic plate with a thick layer of emulsion (50 μ) specially prepared for the registration of H-particles. At a distance of 0·2–0·4 mm of the plate, there was placed a paraffin film and thus were registered the protons ejected by the neutrons from paraffin (Fig. 1). Radioactive isotopes were being produced in red phosphorus by neutron bombardment. A glass tube containing radon (about 250 mc.) and some powdered beryllium served as the source of neutrons. Every 10-minutes the bombarded phosphorus was brought into the immediate neighbourhood of the photographic plate for a period of

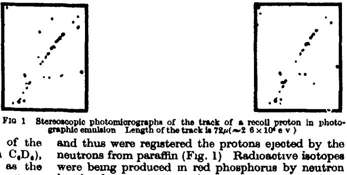

FIG 1 Stereoscopic photomicrographs of the track of a recoil proton in photographic emulsion. Length of the track is $72\mu (\sim 2{\cdot}6 \times 10^6$ e.v.)

10 minutes. The total time of the experiment was about 12 hours

As a result there was revealed the presence of 15 recoil protons the energy of which is represented graphically in Fig 2 (protons of energy 10^6 e v and above are detected by this method) The greatest energy of the observed protons was $\sim 4 \times 10^6$ e v Thus the upper energy limit of the neutrons spontaneously emitted by some disintegration products of phosphorus is at any rate $\geqslant 4 \times 10^6$ e v

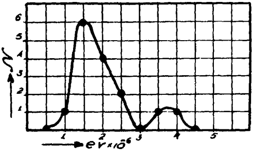

FIG 2

In conclusion, I wish to express my best thanks to Mr A Jdanoff for his kind help

I GUREVICH

State Radium Institute and
Physical-Technical Institute,
Leningrad
March 10

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[1] C R, 198, 2089, 1934

The Fundamental Paradox of the Quantum Theory

ACCORDING to the general principles of the quantum theory, physical variables $a, b, c,$ are represented by symmetric linear operators $A, B, C,$. in Hilbertian space; and the representation satisfies the following conditions:

$$a^2 \rightarrow A^2, \lambda a \rightarrow \lambda A, (\lambda \text{ being an ordinary number})$$
$$a + b \rightarrow A + B$$

Since $ab = \frac{1}{4}(a + b)^2 - \frac{1}{4}(a - b)^2$,
it follows that $ab \rightarrow \frac{1}{2}(AB + BA)$

Similarly,

$$ab.c \rightarrow \tfrac{1}{4}(AB + BA)C + \tfrac{1}{4}C(AB + BA),$$
$$ca.b \rightarrow \tfrac{1}{4}(CA + AC)B + \tfrac{1}{4}B(CA + AC),$$
$$bc.a \rightarrow \tfrac{1}{4}(BC + CB)A + \tfrac{1}{4}A(BC + CB)$$

The general principles will therefore lead to a contradiction unless these three operational representations of abc are all equal. This implies that

$$A(BC - CB) = (BC - CB)A,$$

with two similar equations. Hence the commutator $(BC - CB)$ of any two operators representing physical variables must commute with every operator representing a physical variable Therefore, by Schur's lemma, $(BC - CB)$ must be a numerical multiple, $\lambda_{BC}I$, of the unit matrix I, in any irreducible matrix representation.

Now, if $ab \rightarrow X$,

$$\lambda_{XC}I = XC - CX = \tfrac{1}{2}(AB + BA)C - \tfrac{1}{2}C(AB + BA)$$
$$= \lambda_{BC}A + \lambda_{AC}B.$$

Hence $\lambda_{XC} = \lambda_{BC} = \lambda_{AC} = 0$, and all the commutators vanish Therefore any *two operators which represent physical variables must commute*. This result can only be reconciled with the accepted exchange relations by taking the numerical value of Planck's constant to be zero This destroys the whole structure of the modern form of the quantum theory

G TEMPLE

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May 18

Chromosomes of the Tulip in Mitosis

IN a recent study of the development of the male gamete in the style of *Lilium regale*, O'Mara[1] states that no equatorial plate is formed, but that at metaphase the chromosomes lie scattered in the pollen tube Welsford[2], on the other hand, illustrates in *L. Martagon* (her Fig 16) the complement normally arranged on a plate

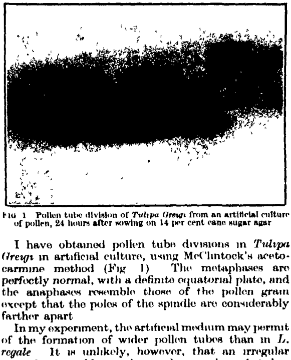

FIG 1 Pollen tube division of *Tulipa Greigi* from an artificial culture of pollen, 24 hours after sowing on 14 per cent cane sugar agar

I have obtained pollen tube divisions in *Tulipa Greigi* in artificial culture, using McClintock's aceto-carmine method (Fig 1) The metaphases are perfectly normal, with a definite equatorial plate, and the anaphases resemble those of the pollen grain except that the poles of the spindle are considerably farther apart

In my experiment, the artificial medium may permit of the formation of wider pollen tubes than in *L. regale* It is unlikely, however, that an irregular metaphase would give the regular anaphase distribution required to produce the viable gametes of this species More probably, therefore, a true metaphase plate is formed, though the stage may be rapid and not easy to find

The technique which I have used further reveals the structure of the mitotic chromosomes in a way not otherwise possible The method can only be applied to the study of mitosis in pollen grains and pollen tubes, but the thick wall of the pollen grain apparently modifies the action of the fixative

By this fixation the chromosomes show striations which are independent in each chromatid, and are presumably caused by a slight separation of the coils of the spiral chromosome thread It is not possible to determine the direction of coiling, but there is evidently no change of direction, since there are no breaks in the spacing of the coils

The following measurements show the sizes of the structures involved:

Length of arm of chromosome	17 0 μ
No of spirals	33
Diameter of chromatid	1 2 μ
Calculated diameter of chromosome thread = $\frac{17\ 0}{33}\ \mu$ =	0 52 μ.

Evidently the structures shown by this technique are comparable with those illustrated by Vejdovsky at metaphase in *Ascaris*[3] and by Darlington at telophase in *Fritillaria*[4] The whole volume of each chromatid is taken up by a chromosome thread 0 5 μ in diameter compactly coiled to give a rod approximately twice its diameter.

These findings are therefore incompatible with those of Sharp[5] and other workers of the chromonema-matrix school

M B UPCOTT

John Innes Horticultural Institution,
Merton Park, London, S W 19
May 1.

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[1] O'Mara, J, *Bot Gaz*, **94**, 1933
[2] Welsford, E S, *Ann Bot*, **28** 1914
[3] Wilson, E B, "The Cell in Development and Heredity" (New York, 1925) Fig 59
[4] Darlington, C D, *Proc Roy Soc*, B, **117** (in the press)
[5] Sharp, L W, *Bot Gaz*, **88**, 1929

Use of Reflected Light in the Examination of Fossils

SEVERAL very ingenious methods for facilitating the microscopic examination of the structure of plant fossils have been recently described and illustrated in NATURE No mention, so far as I have noted, has been made of that by which the smoothed surface of a fossiliferous rock is examined by reflected light, as may be done with the 'ultropak' microscope. In this instrument, as many will know, the light is introduced laterally into the body of the microscope, reflected downwards by an annular mirror and brought to a focus by an annular condenser in front of the objective

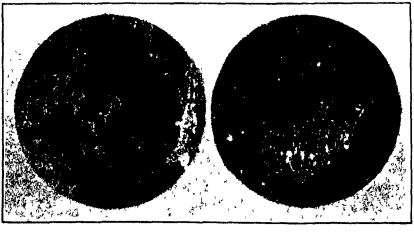

FIG. 1 Photomicrographs of coal Left hand Megaspore or megasporangium on smoothed surface of Wigan coal parallel to bedding × 32 5 diam. Right hand. Transverse section of stem seen on smoothed surface of Westphalian coal. × 75 diam.

The accompanying photomicrographs (Fig 1) were made by this way, from ordinary coal. The method is equally applicable to siliceous and calcareous fossils, but the results, obtained with a few minutes' preparation from coal fossils, usually so hard to deal with, seemed to me most surprising Higher magnifications giving 300–400 diameters with oil-immersion lenses are also feasible.

HENRY H. DIXON

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May 2.

Effect of Orange Juice on the Growth of *Laminaria* Gametophytes

SOME interesting nutritional effects have been observed in cultures of gametophytic and young sporophytic plants of *Laminaria saccharina* Lamour by the addition of low concentrations of orange and other fruit juices After the *Laminaria* spores had been introduced into petri dishes containing 25 c c of filtered sea-water, orange juice was added in the proportion of 1 c c of a 1 per cent extract to each dish Control cultures were kept under identical conditions of light and temperature

Normally, on germination the contents of the spore pass through the germ-tube into the enlarged distal end, giving the early stage of the 'effective plant' In cultures containing sea-water alone, the young gametophytes remained in this condition for a period varying from a few days to some weeks In cultures to which orange juice has been added, this temporary resting stage is greatly reduced

Previous investigators have shown that sexual organs may be produced either in the one-celled condition or from any cell of a filamentous gametophyte. The filamentous form of gametophyte is produced either when temperature and light intensity are high, or when phosphate is present in excess of nitrate[1]. The presence of orange juice stimulates the formation of filamentous gametophytes and also the production of sexual organs (Fig. 1, *a* and *b*)

Algologists have frequently observed that, in culture, the plants floating in the surface film of the medium show reactions different from those of the submerged plants. It is, perhaps, not without significance that in cultures to which orange juice has been added, the greatest growth is usually observed in the submerged germlings.

Analyses of sea-water made at different times of the year show a marked diminution in the amounts of dissolved nitrate and phosphate present during the spring and early summer. Experiments carried out with cultures supplied with 1 c.c. of 0·01 molar potassium nitrate, potassium iodide and potassium phosphate in addition to the fruit juices show an acceleration of growth and development which is equally marked (Fig. 1, *c* and *d*). Vigorous young sporophytes have been produced in these treated cultures.

Further experiments are in progress to determine the effect of different concentrations of various fruit juices, of the addition of ascorbic acid (vitamin C) contained in these juices and of other growth-promoting substances[3] which are known to contain nucleic acid or its derivatives

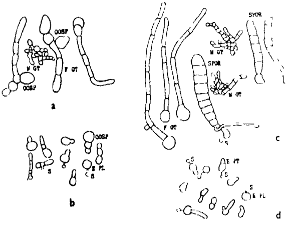

FIG. 1 Cultures 40 days old of germinating spores of *Laminaria saccharina* Lamour

a, Gametophytes from culture in sea-water to which 1 c c of 1 per cent extract orange juice was added

b, Gametophytes from control culture, sea-water alone

c, Gametophytes and young sporophytes from culture of sea water and added inorganic salts, with 1 c c of 1 per cent extract orange juice

d, Gametophytes from control, sea water and inorganic salts

s, Spore, *e pl*, 'effective plant', *oosp*, oosphere, *m gt*, male gametophyte, *f gt*, female gametophyte, *spor*, young sporophyte

P W CARTER

Botanical Department,
University College,
Aberystwyth. May 15.

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[1] Harries, *Ann Bot*, **46**, 893, 1932

[2] Mockeridge, *Biochem J*, **14**, 732, 1920 *J Exper Biol*, **4**, 301, 1927

Birds and Butterflies

IN reference to the palatability of butterflies, it may be interesting to record that the Australian grey butcher bird, *Cracticus torquatus*, does not object to eating butterflies A tame bird which I have had under observation, though pinioned, manages to catch skippers of the species *Anasynta sphenosena*, when these are flying round flowers within reach. I have also seen the bird catch the same species in the early morning before the butterflies have become active. The butterflies are seized with the bill, beaten once or twice against the ground or against some hard object, and then swallowed whole. The fact that on one occasion the bird caught and ate a skipper soon after it had been fed with its customary ration of raw meat indicates that it was not hunger that persuaded the bird to take the butterfly.

The same bird also eats the introduced sand hill snail, *Helix pisana*. The victim may be either crushed with the powerful bill or beaten against the ground, but an anvil stone such as used by the English thrush is not utilised. Much of the shell is swallowed, to be disgorged later in the pellet Examination of these pellets also shows that ants are freely eaten.

L. GLAUERT
(Curator of Museum).

Public Library, Museum and
Art Gallery,
Perth, Australia.
April 12.

Chemistry of Œstrogenic Substances

IN view of the results published by E. Friedmann in NATURE of April 20, we decided to investigate the effect upon ovariectomised rats of the two compounds specifically mentioned by him as œstrogenic, namely, sodium benzylidenepyruvate and sodium furylidenepyruvate These were prepared and purified exactly as described by Friedmann[1] They were dissolved in water, the strength being 100 mgm in 3 c c, and administered in 6 doses of 0·5 c c, each compound being injected into 5 rats The technique employed was that described in the paper by Allan, Dickens and Dodds[2]

A similar experiment was performed using the two free acids (100 mgm dissolved in 3 c c of sesame oil and divided into 6 doses of 0 5 c c), five rats being used for each of the two acids

Examination of the vaginal smears showed that there was no œstrogenic activity either with aqueous solutions of the sodium salts or with solutions of the free acids in oil when injected in amounts of 100 mgm per rat

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E. C DODDS.

Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W 1.

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[1] Friedmann, E *Helv Chim Acta*, **14**, 783, 1931

[2] Allan, H, Dickens, F, and Dodds, E C, *J Physiol*, **68**, 348, 1930

Research and the Library

THE suggestions of Drs Berry and Bonser on this subject[1] will be of interest to all who are appalled by the unabating flood of scientific literature

There are two points to which I would direct attention First they state: "It has long been the practice of chemical journals to accept only new matter, and this cut down to the briefest account. This principle can be adopted with advantage in other scientific subjects" Chemistry is an exact science, and what may be an excellent method of presenting its results may not be best for a biological subject. In zoology a statement of results or observations is valueless unless it is followed by a discussion in which the new results are correctly orientated in relation to previously known facts Facts by themselves mean nothing, only when they are seriated into a hypothesis do they take on any value.

The adoption by certain zoological journals of the criteria of chemical journals has had the unfortunate effect of restricting discussion and has produced a multitude of isolated pieces of information Thus I cannot agree with Drs Berry and Bonser when they suggest that accounts of the debates of certain societies should not be published, for by ordered discussion alone can science be advanced. The mere accumulation of details and isolated facts is not scientific advancement

A scientific paper should consist of three parts: an introduction explaining why and how the investigation was undertaken; the observations; and finally their interpretation. If all papers were so composed and there was adequate discussion of all points raised, not only would the publication of incomplete work be checked, but also the number of papers published would be halved, for the discussion would show the writer that half the facts he would normally record are insignificant details having no bearing on his general argument

Secondly, the suggestion of Drs Berry and Bonsor that there is a tendency for the young research worker to be judged upon the number of his papers rather than on their quality, gives rise to many thoughts which cannot be touched on here But it does prompt the question as to how much research is done with the idea of the advancement of some branch of science and how much for added professional qualification To-day, even for minor posts, candidates are expected to have research qualifications, and quantity rather than quality will continue to count unless those responsible for making such appointments are prepared either to seek such expert advice on the publications of the candidates as they would for a senior post, or to pay less attention to this aspect of the qualifications

Whether the apparent respect paid to all forms of research is genuine is another matter, for the reward for the most brilliant research would appear to be, not the means and leisure to continue it, but a post involving such administrative or teaching duties as to make further research impossible

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Department of Zoology,
University of Glasgow

[1] NATURE, 135, 664, April 27, 1935

Plasticity of Rock Salt and the Taylor and Becker-Orowan Theories of Crystalline Plasticity

IN Prof Taylor's theory of crystalline plasticity[1] the process of slip is conceived as the result of the propagation through the lattice of a definite type of deviations from the 'ideal' structure, so called dislocations[2] The path of a single dislocation in general is limited by the faults or flaws in the crystal and it is assumed that the number N of propagated dislocations increases during the course of the process Every dislocation is the centre of a field of stress, the various dislocations *influence each other's motions* and it is shown that centres will escape from each other only if the applied exterior stress exceeds a certain value, increasing with N Hence the stress necessary for further deformation increases with the deformation already attained ('shear hardening') It is suggested by Taylor that the dislocations might arise as a consequence of thermal agitation, but no explicit explanation is given of the progressive increase of N

Now, in the Becker-Orowan theory, gliding is conceived as starting from 'jumps', originating at favourably situated flaws under the combined influence of the exterior stress τ (enhanced by the so-called stress-concentration effect), and of thermal agitation (producing local stress fluctuations[3]) This conception leads to a relation between τ and the rate of flow, from which also the minimum value τ_f necessary to produce an observable rate of shear at a given temperature can be estimated. It is put forward by Orowan (l c, p. 639) that these local jumps initiate dislocations of similar type as considered in Taylor's theory If such dislocations, once formed, move only over a finite distance and are then arrested at 'opaque' flaws, it would seem to us that they will give rise to an 'interior' field (similar to that introduced by Taylor, though now essentially connected with the lattice distortions at the places where dislocations have been arrested), of a stress τ_i increasing with the number of dislocations formed In those regions where jumps have occurred the interior field in the main will counteract the exterior field, and thus we must expect that the production of new dislocations will take place at a continuously decreasing rate When τ_i has increased so much that $\tau - \tau_i$ approaches to the value τ_f, the deformation practically comes to a stop, as then new dislocations are formed so slowly that their only effect will be a very small creep. Reasoning along these lines it seems possible to arrive at a combination of the two theories, which explains both the shear hardening effect and the dependence of the rate of flow upon exterior stress and temperature[4].

The picture obtained suggests that the plastic properties of a crystal will be enhanced if it is possible to keep down the interior field τ_i It seems worth while to consider from this point of view the remarkable fact, observed by Smekal[5], that on stretching a piece of rock salt the actual gliding among several equivalent sets of glide planes chooses that set, for which the direction of gliding occupies the shortest way in the piece If it is assumed that a certain proportion of the dislocations which arrive at the surface layer of the crystal are able to 'escape', so that they do not contribute to the interior field, the *interior field* for a given total shear will be the smaller when the number of dislocations that can arrive at the surface is greatest, which will be the case for the shortest glide path

To some extent, similar reasoning may perhaps help to understand the much discussed influence of water on the plasticity of rock salt If the water has a 'healing' effect on the surface layers, those dislocations which were arrested by flaws in these layers can escape, and thus a decrease of τ_i will be effected This means that a definite exterior stress can give rise to the birth of a larger number of dislocations and thus to a larger shear

The above suggested 'explanation' of the Joffé effect as a 'surface effect' apparently fits in with the conceptions of W Ewald and M Polanyi[6] If it were assumed, as has been proposed by Smekal and co-workers[7], that the water penetrates into the crystal, an increase in plasticity could be effected also if the 'opacity' of *internal* flaws for the passage of dislocations were diminished, thus increasing their mean 'free path' L This second explanation would be similar in nature to that accepted by Taylor for the influence of temperature on the degree of plasticity

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Eindhoven, Holland.

J M BURGERS

Aerodynamical Laboratory,
Delft
March 18.

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[1] G I Taylor, *Proc Roy. Soc*, A, 145, 362, 388, 405, 1934

[2] Compare also M Polanyi, *Z Physik*, 89, 660, 1934

[3] R Becker, *Physik Z*, 26, 919, 1925 E Orowan, *Z Physik*, 89, 605, 614, 634, 1934

[4] This will be set forth in more detail in Chapter V (section 11) of a "Report on Viscosity and Plasticity" published by the Royal Academy of Sciences at Amsterdam in its *Verhandelingen* (section I 15, No 3, 1935)

[5] A Smekal, *Z Physik*, 93, 166; 1935

[6] W Ewald and M Polanyi, *Z. Physik*, 28, 29, 1924 M Polanyi, *ibid*, 89, 660, 1934

[7] See, for example, K. Wendenburg, *ibid*, 88, 727; 1934.

Electrical Properties of Wires of High Permeability

In the course of an investigation into the properties of wires of the high permeability nickel-iron alloys of the mumetal group, we have found some interesting results when such wires are made to carry alternating current at audio-frequencies

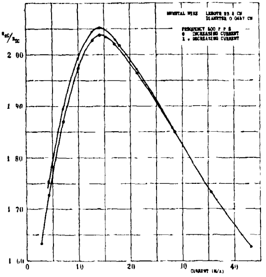

FIG 1

There is a pronounced 'skin effect' even in fine wires, owing to their abnormal permeability, at frequencies as low as 50 periods per second, at present the limit of our experiments In addition, the application to the wire of a small external axial magnetic field of the order of that of the earth, causes a strikingly large change in its impedance

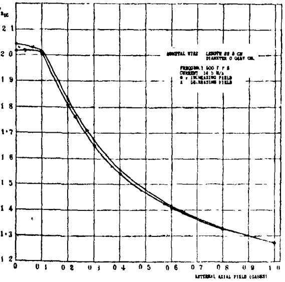

FIG 2

When the external field is constant it is found that the effective (A C.) resistance varies with the value of the alternating current in the wire, and for any frequency always comes to a maximum for some particular current which for convenience we may call the optimum current for the wire at that frequency As an example, in a mumetal wire, 23 5 cm long and 0 0457 cm in diameter (dimension ratio 510) suitably heat-treated, the variation of effective resistance with current at a frequency of 500 p p s is shown in Fig 1 It will be observed that there is a slight but appreciable hysteresis effect

When the current in the wire is kept constant at the 'optimum' value of 14 5 milli-amperes, and the external axial magnetic field is varied, the variation of effective resistance is shown in Fig 2 A small hysteresis effect is again noticeable For currents either larger or smaller than the optimum, the corresponding field-resistance curves lie below that shown in Fig 2, and their maximum gradients are smaller

Changes in reactance as current or external field is varied also occur, but are in general smaller than those of effective resistance

By using a wire with a larger dimension ratio, the changes of effective resistance in fields less than 0 2 gauss may be considerably increased As an example, a wire of length 15 25 cm and diameter 0 0179 cm (dimension ratio 850) carrying A C at 500 p p s. and lying horizontally at right angles to the magnetic meridian, suffered a decrease in effective resistance of about 18 per cent when turned through 90° in the horizontal plane This, combined with a power factor in the wire of 0 97, means an impedance change of about 17 per cent, if the small reactance change be ignored

A detailed account of these experiments will shortly be published elsewhere

We are indebted to the Admiralty for permission to publish this note

E P HARRISON
G L TURNEY
H ROWE

Mine Design Department,
H M S *Vernon*,
Portsmouth.
April 5

Thermal Oxidation of Formaldehyde

CARRUTHERS and Norrish[1] have observed that the polymerisation of formaldehyde is induced by formic acid, produced in the photochemical oxidation An induced polymerisation apparently accompanied by an induced decomposition occurs in the thermal oxidation, at temperatures as high as 317° This reaction possesses many features of interest from the point of view of the theory of chain reactions Direct analysis has shown that the rate changes with time as predicted by the theory for chains with degenerate branching[2] Furthermore, in a series of mixtures, the initial rate depends on the third power of the formaldehyde concentration and is independent of oxygen concentration down to pressures of a few millimetres In a single experiment, however, these conditions do not hold good, and with a sufficiently high initial velocity, good unimolecular constants can be obtained over a large range.

It is not easy to explain this effect by a catalysis due to the final products, but Semenoff[2] has shown that such behaviour is to be expected in reactions where there is a mutual interaction of chains Perhaps the most unusual feature occurs in the experiments with vessels of different diameter No considerable difference could be observed in the amounts of CO and CO_2 produced in a given time in a series of vessels ranging from a 161 c c bulb down to a 1 mm capillary tube, despite the fact that polymerisation in the narrow tubes was sufficiently rapid to cause a considerable diminution in pressure instead of the usual increase due to the reaction $2H\,CHO + O_2 \rightarrow 2CO + 2H_2O$ However, when a tube packed with powdered Pyrex glass was substituted, the course of the reaction changed and the gaseous product consisted almost entirely of CO_2 Packing has a similar effect on the course of the oxidation of acetylene[4], but the rate of production of CO falls off rapidly when the diameter is decreased below 6 mm[5] This critical region of diameters, if it exists, must lie well below 1 mm in the case of formaldehyde, yet the other characteristics of the reaction are certainly indicative of a chain mechanism

R SPENCE.

The University,
Leeds

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[1] Carruthers and Norrish, NATURE, 135, 582, 1935

[2] Semenoff, "Chemical Kinetics and Chain Reactions", p 367

[3] Semenoff, *Z phys Chem*, 28 B, 54, 1935

[4] Kistiakowsky and Lenher, *J Amer Chem Soc*, 52, 3785, 1930

[5] Spence, *J Chem Soc*, 686, 1932

Points from Foregoing Letters

THE addition of echo sounding gear to the *Johan Hjort* enabled that vessel to reveal unsuspected features of the flooring of deep fjords, and to locate swarms of spawning cod in the neighbourhood of Lofoten. These, writes Oscar Sund, were mainly in a layer of 10–12 metres thick at a constant depth where a somewhat lower oxygen concentration and greater acidity could also be detected

Prof S K Mitra and P Syam report the detection of radio waves returned from a height of only 55 km Although these have only been detected occasionally, the authors believe that the ionised layers to which the effect is due exist usually in a diffused form which strongly absorbs longer waves, and affects the virtual height of the Kennelly Heaviside region above it

An error in sign (later corrected) in Prof Sommerfeld's original paper on the attenuation of radio waves had led to the prediction of a zero field intensity at finite distances from a radio transmitter K A Norton points this out and gives a new empirical formula for the field intensity, applicable, however, only to a plane earth

The existence of a cadmium isotope of mass 118 has been deduced from the band spectrum of the light emitted by cadmium hydrides, but has not been identified by means of the mass-spectrograph. Gösta Stenvinkel and Erik Svensson claim that the evidence from the spectrum of the light emitted by the hydrides is conclusive, as is shown by its ability to detect the existence of other known isotopes of cadmium and zinc, for which the mass-spectroscopic evidence is conflicting

The introduction of heavy hydrogen in place of the ordinary variety in organic compounds changes the Raman spectrum of the light scattered by those compounds From the shift observed in certain spectrum lines of benzene, A Klit and Dr A Langseth associate some of the spectrum lines with the structural characters of the benzene molecules

The neutrons spontaneously emitted by phosphorus previously bombarded with other neutrons (from a radon-beryllium source) may possess more than four million volts energy In I. Gurevich's view, neutron emission is a secondary process, and not a primary process as suggested by Curie, Joliot and Preiswerk.

From the general principles of the quantum theory, Prof. G. Temple deduces the paradox that any two 'operators' which represent physical variables must commute. This would make Planck's constant zero.

The arrangement of the chromosomes during cell division in the pollen tube of the tulip is found by Miss M B Upcott to be normal, unlike the behaviour reported by O'Mara in the case of the *Lilium regale*. From measurements of the structures involved, Miss Upcott concludes that the whole volume of the chromatid is taken by a chromosome thread compactly coiled

Prof H H Dixon submits photomicrographs of coal by reflected light, taken with the 'ultropak' type of microscope in which the light is introduced laterally into the body of the microscope, and reflected downwards by an annular mirror

The addition of orange juice to sea-water quickens the development of the sea-weed, *Laminaria saccharina* (sugar wrack) in its early stages, the greatest growth being observed in submerged germlings P W Carter gives diagrams showing this effect, and also that of the addition of potassium salts.

As a contribution to the discussion on the palatability of butterflies, L Glauert writes that he has observed the Australian butcher-bird catching specimens of the species *Anasynta sphenosena* even when not driven by hunger.

Experiments by Profs J W Cook and E C Dodds fail to confirm the recent observations of E. Friedmann on the œstrogenic activity of sodium benzylidenepyruvate and sodium furylidenepyruvate upon rats

In order to explain the progressive increase in the shearing force needed, and the irreversible deformation with temperature in the case of experiments with rock-salt, Dr. W. G. Burgers and J. M. Burgers propose a combination of the theories of Taylor and of Becker-Orowan. The new theory, it is claimed, also explains the increased plasticity of rock-salt in process of solution, ascribing this behaviour to a surface effect, as against Smekal's hypothesis of internal cracks.

Nickel-iron wires of high permeability show an abnormal 'skin effect' (mainly surface conduction, owing to increased internal resistance) for low audio-frequencies. An external magnetic field increases the resistance. Dr. E. P. Harrison, G. L. Turney and H Rowe give graphs showing the variation of the resistance with current strength and with the external magnetic field.

The presence of powdered glass changes the course of polymerisation and decomposition of formaldehyde (at temperatures up to 317°), producing carbon dioxide instead of carbon monoxide and water. Dr R. Spence interprets this effect as due to the breaking of the reaction chains owing to deactivation of active molecules by collision with increased surface.

Research Items

Giant Hand-Axe from Sheringham, Norfolk An altogether remarkable and gigantic hand-axe, discovered embedded in the beach below Beeston Hill, Sheringham, by Mr J P T Burchell, has been figured and described by Mr J Reid Moir (*Proc Prehistoric Soc East Anglia*, 7, Pt 3) The implement measures in its greatest length 15½ inches, in greatest width 6¼ inches, in greatest thickness 5¼ inches Its weight is approximately 14½ lb It was derived originally from the base of the Cromer Forest bed, which rests upon the surface of the chalk The implementiferous bed runs in beneath the Forest Bed strata and the glacial deposits which form the cliff, some 200 ft in height. The material of the axe is of flint, the colour of the flaked surfaces being jet black The ridges and outstanding parts are abraded, and it is striated in places There is a small area of the cortex remaining, which shows a ferruginous staining It is a specimen of the 'platessiform' type, that is, rhomboidal in section in the anterior portion and showing the remains of both the dorsal and ventral planes or platforms of the rostro carinate stage In two other specimens cited for purposes of comparison, coming from East and West Runton, one is clearly of the 'platessiform' type, but the ventral plane is partly transformed into a cutting edge, while the second is equally clearly of the 'batiform' type, in which the section through the anterior portion is triangular in section, the lower angles of the triangle representing the cutting edges Hand-axes showing these characteristics have been discovered not only in England but also widely distributed over the earth's surface The numerous specimens discovered in the basement bed, belonging to the early Pleistocene epoch, are as highly specialised as are those of any later prehistoric period and represent a very definite and necessary stage in implemental development No adequate explanation of the purpose which the gigantic size of the Sheringham axe could serve has been offered

Racial History in Scandinavia. Dr Stanislas Zejmzejmis has constructed an anthropological map of Scandinavia, and from this has reconstructed the racial history of the peninsula in the light of archæological and historical material. He has drawn his anthropological data mainly from military statistics and other published material, which he has analysed in accordance with the anthropological methods of Czekanowski (*L'Anthropologie*, 45, 1–2) The existence of four physical types is established as 'fundamental' in the sense of Czekanowski Mediterranean, Nordic, Lapoid and Armenoid The Mediterranean provinces, which play an important part in the peninsula, are centrally situated at Dalecarlia in Sweden, and Hedmark and Oppland in Norway They are surrounded by provinces of transition in which the Mediterranean type diminishes in favour of the Nordic or Lapoid. The essentially Nordic provinces form not one, but two zones, the first in southern Sweden (Skaraborgs, Jänköpings, Oestergötlands, Göteborgs, Aelvsborgs), the second in Norway (North and South Tröndelag), lying on each side of the lenticular centre. Outside these provinces are territories in which is found a strong proportion of the Lapoid element In the north of Norway (Tromsø and Finmark) this reaches as high as 33 per cent In Sweden the proportion is not so great, in the south, Scania and the adjacent regions correspond to the Norwegian Rogaland The Armenoid does not play an important part, and nowhere does it exceed 3–5 per cent The most ancient stratum of the prehistoric population (for example, Stagenas of the Ancylus period) is Mediterranean, possibly Cro-Magnon It is followed by the Lapoids of the south, who possibly are to be related to Ofnet The northern Lapoids are distinct and later, being Laps The Nordics appear with the last great neolithic migration into Scandinavia The brachycephals of southern Scandinavia are to be closely associated with Maglemose and the Danish kitchen middens The Nordics belong to the following Littorina period when the climate of Europe, becoming drier, was favourable to their nomadic habits The Norwegian Nordics are of secondary origin The Armenoids appear to have arrived at the end of the neolithic or beginning of the bronze age

Spearman's General Factor in Mental Activity. *Character and Personality*, 3, No 2, contains an article, "On the Nature of Spearman's General Factor", by Prof Wm McDougall He presents Prof Spearman's case for the existence of a general factor, usually represented by the letter *G*, which enters into all mental activity and is revealed in mental testing, and he considers the problem of determining the nature of *G* Two questions arise First, in what kind of operation does *G* most clearly manifest itself? Secondly, what is the underlying cause or condition which thus manifests itself? To the first question a satisfactory answer can be given, but the second presents a number of problems Spearman favours "a quantity of intellective energy" as the answer McDougall criticises this view, and suggests that both the supply and the direction of energy should be considered, and that a definition of *G* as "power of effective concentration of energy" is nearer the truth. The study of the effect of emotional excitement on cognitive activity, and the lack of any common factor so far from tests on animals, leads to the conclusion that 'integration' is the answer to the problem "In proportion to the degree of integration achieved the whole mind works as one system which dominates and controls all its parts" Prof. McDougall does not claim that his solution is final, but his arguments are stimulating and convincing

Chinese Fishes. In the *Journal of the Shanghai Science Institute* (Section 3, vol 1, 1934), Mr Shigeru Kimura publishes a "Description of the Fishes collected from the Yangtze-kiang, China, by late Dr. K. Kishinouye and his Party in 1927–1929" The collection is very large and of considerable interest, coming from the tributaries of Yangtze-kiang, from Szechwan Province, and consisting of fishes belonging to 63 genera and 28 families There are among them 11 new species, one of which is a handsome member of the Salmonidæ, *Hucho bleekeri*, represented by one specimen only from a mountain stream The name *Hucho* is from *Hu yu*, meaning tiger-fish, a name given by the natives to various different forms Seven new species belong to the Cyprinidæ, and one each to the Cobitidæ, Siluridæ and Bagridæ. The paper is well illustrated by plates in black and white, and there is a map showing the localities from which the material was collected.

Crustacea of the Vanderbilt Expeditions. The fifth volume of the "Scientific Results of the World Cruise of the Yacht *Alva*", 1931, with William K. Vanderbilt commanding, deals with Crustacea (*Stomatopoda* and *Brachyura*. By Lee Boone. *Bull. Vanderbilt Marine Mus.*, 5, 1934. Huntington, L.I., New York, U.S.A. Printed Privately.) It describes the zoological material personally collected by Mr. Vanderbilt during a series of cruises in his yachts, and deposited in his marine museum. The latest collections were made by the yacht *Alva*, and the present work is as beautifully printed and illustrated as were the former volumes. Miss Lee Boone describes every species in detail, many of them being very rare, citing the type of each and where it is to be found, its distribution and reference to previous descriptions. There are three new species of crabs: *Actæomorpha alvæ*, an interesting form representative of a little-known genus of the family Leucosiidæ and resembling in appearance the canceroid genus *Actæa*; *Lissocarcinus elegans*, a new swimming crab connecting the sub-family Caphyrinæ with the Lupinæ; and *Actæa aphrodita*, a pretty little crab from the coral reefs of Bali. Colour plates and notes of several forms were made at the time of collecting by Mr. W. E. Belanske, staff artist of the expedition, under the direction of Mr. Vanderbilt, and are deposited in the Vanderbilt Marine Museum.

Storage of Avocado Pears. As Memoir No. 1, the Low Temperature Research Station of the Imperial College of Tropical Agriculture publishes a study of storage possibilities with Avocado pears, which includes points of both scientific and commercial interest. The authors, Dr. C. W. Wardlaw and Mr. E. R. Leonard, point out that most of the orchards of this plant in the West Indies are stocked with plants grown from seed so that there is great variety in the produce, a diversity which extends to their behaviour in storage conditions and makes their behaviour quite impossible to predict in relation to an export trade. They emphasise, therefore, that the first step, if an export trade is to be built up, is to select certain definite varieties, which these preliminary tests show to possess possibilities, to use these only for purposes of propagation, and to study the behaviour of experimental consignments of these varieties under export conditions. It is suggested that these preliminary exports should be kept at a steady temperature of 45° F. At this temperature many of the local varieties manifest phenomena of 'chilling' which have considerable interest. Maturation processes still continue in the internal tissues in these chilled fruits, but the biochemical processes take an abnormal trend. The onset of chilling is shown to be closely associated with a phase of the process of ripening in the fruit.

Taxonomy of Wild Hybrids. In his presidential address to the Botanical Section of the American Association for the Advancement of Science (*Science*, 81, 161), Prof. K. M. Wiegand discussed the subject of wild hybrids from the taxonomic point of view. He cited his experience with the genus *Amelanchier* in eastern North America, in which, after many sortings of herbarium specimens, he finally reduced them to six piles (species) and a seventh pile including heterogeneous forms with intermediate or combination characters, local distribution and other features of hybrids. In Newfoundland, where the conditions had been disturbed by forest cutting, a mixture of hybrids was found, but in less disturbed areas the plants were more uniform. The conditions of hybridity in various other genera, such as *Crataegus*, *Rubus* and *Quercus*, are discussed, and it is concluded that hybridisation has probably played little part in evolution. The eastern American species are regarded as nearly all going back to the Glacial period or much earlier, and species formation as a very slow process. While this doubtless contains much truth, it is possible that the evolutionary importance of polyploidy, and particularly amphidiploidy, has been underestimated.

Life-History of *Endophyllum sempervivi*. A very full account of the life-history of a rust fungus on house-leek plants has recently been published by Dorothy Ashworth (*Trans. Brit. Mycol. Soc.*, 19, Part 3, 240–258, February 1935). Investigations have been made into almost all the phases of activity of the fungus. Binucleate sporidia germinate to form germ tubes, which penetrate the epidermal walls of the host. Uninucleate mycelium is produced, and spermagonia appear in spring. Masses of æcidial primordia occur at the base of each spermagonium, and after the production of secondary primordia, the hyphæ become binucleate by nuclear migration. Æcidiospores formed from these mycelial threads have four nuclei, and give rise to a tri-septate promycelium from which four sporidia or basidiospores are abstricted. It is interesting to note that æcidia can be formed without the intervention of the spermatia; diploid mycelium can be produced as a result of hyphal fusions. *Endophyllum sempervivi* is a perennial fungus, and the mycelium appears to be always uninucleate until æcidia begin to develop. It is not typical of the rust fungi in that æcidiospores produce basidia directly, without the intervention of uredo- or teleuto-spores.

Ship Waves. T. H. Havelock (*Proc. Roy. Soc.*, A, April 10) has made some calculations on the wave-making resistance of simplified ship forms, taking into account fluid friction. In the absence of fluid friction, the energy absorbed in making waves is the same whether the model is moving bow first or stern first, even when the model is not symmetrical fore and aft. The main effect of fluid friction is to lower the relative wave-making effects of the after parts of the surface, and in some cases calculated the effectiveness of the stern is lowered by about 40 per cent. This reduction introduces a difference between the wave resistances for ahead and astern motion. Calculations are also made of the wave profile using the corrections for fluid friction, and these agree well with observation.

Rotation of Molecules in Liquids. X-ray studies have shown that the molecules of a liquid possess a spatial distribution comparable with that occurring in a crystalline solid. The centre of gravity of a liquid molecule can be imagined as oscillating about a point which is itself slowly moving. Furthermore, there exists a coupling between neighbouring molecules, and hence the latter cannot be considered as completely free to rotate. Instead, they are constrained to perform rotatory oscillations about an axis the orientation of which varies slowly. The effect of this constraint on the molecular polarisation and the Kerr effect of a liquid substance has been examined by P. Debye (*Bull. Classe Sci., Acad. roy. Belg.*, 31, 166; 1935). The calculation shows that the coupling, measured by the energy required to rotate a molecule through 90°, is quite large, being as much as 10 kT for water. The fact that the molecular polarisation and the Kerr effect of a substance in solution are both less than for the same substance in the vapour state also follows from the theory. Thus the effect of dissolving monochlorobenzene in hexane is completely explicable on the basis of a coupling energy equal to 0·75 kT.

Negative Ions in the Glow Discharge Little work has been done on negative ions in the glow discharge, and they are commonly neglected in theories of the discharge. J L Spencer Smith has carried out careful work on the glow discharge in iodine (*Phil Mag*, April and May, 1935), and he finds that in this vapour negative ions are present in large numbers and exert a strong influence In one series of experiments various regions of the discharge were investigated by the Langmuir probe method, and an analysis of the probe currents showed that negative ions are present in numbers about equal to the positive ions In further work, negative ions from the discharge were drawn through a perforated probe electrode into an independently exhausted space and analysed by a magnetic field I^-, I_2^- and I_3^- ions were found The beams of negative ions obtained in this way were used for some approximate measurements of the collision probability between negative ions and neutral iodine molecules by measuring the absorption of the beams in iodine vapour

New Method of Distinguishing Amylases Basing himself upon the observations of Wijsman (*Rev Trav Chim*, 9, 1, 1890), K Venkata Giri has recently suggested a simple qualitative method of characterising different amylases which may prove to have a wide range of usefulness (*J Indian Inst. Sci* 17A, 11, 127-129) A small drop of the enzyme is added to an agar gel carrying a suspension of starch and allowed to diffuse for 24–28 hours at laboratory temperature The gel is in a Petri dish, and at the end of this period a dilute solution of iodine is poured on for a few minutes, until the diffusion zones show clearly In the case of β-amylase the central diffusion zone is coloured violet ; in the case of α-amylase it is colourless The results of its use with taka-diastase, salivary amylase and pancreatic amylase are described

Standard Methods for Testing Wood Preservatives In 1930, a conference was held in Berlin to discuss the possibility of arriving at a standard method for testing the toxicity of wood preservatives in the laboratory At this conference there was general agreement as to the form which the tests should take, and a report of the decisions taken was published in NATURE (126, 921, 1930) A committee was set up at the meeting to organise a series of co-operative tests to determine how far the suggested method could give consistent results when carried out in different laboratories by different workers, and to settle details of technique. The results of the committee's work have been published in *Angewandte Chemie* (48, 21 ; 1935) in which is given an account of the experiments made in order to compare the activity of various isolations of the different test fungi chosen, and of the results obtained in different laboratories in comparative tests on identical samples of sodium fluoride and creosote A detailed description of the standard method adopted for carrying out the recommended wood block test (*Klötzchenmethode*) is also included, together with a note on the 'agar' method (*Rohrchenmethode*) It is to be hoped that, in future, laboratory tests upon the toxicity of wood preservatives will be carried out, so far as possible, by this standard method, so that results obtained in different laboratories may be directly comparable

Boundary Friction of Oxidised Lubricating Oils. Dr Redgrove's paper on the "Boundary Friction of Oxidised Lubricating Oils", read before the Institution of Petroleum Technologists on April 9, is in fact an account of experiments conducted during the period 1927–31 Conclusions then reached agree substantially with those obtained as a result of more recent research, even though the particular problems under consideration were attacked from an entirely different angle Since small percentages of the higher fatty acids improve lubricating qualities of mineral oils under boundary conditions, experiments were made to ascertain whether the less volatile petroleum acids exerted a like beneficial effect Preliminary investigations with blends of a mixed base distillate oil and 1 per cent of fatty acids showed that there was a definite variation of coefficient of friction with temperature A special apparatus was, therefore, designed in which temperature could be rigidly controlled, and results proved that the lower molecular weight fatty acids do not reduce the coefficient of static friction of mineral lubricating oils under boundary conditions Moreover, they showed that the true criterion of lubricating values is rather the effective length of the hydrocarbon chain, normal to the bearing surfaces, attached to the adsorbed polar group, than the volume of the molecule The greater the length of this hydrocarbon chain, the greater the flexibility of adsorbed molecules Such a theory in conjunction with thermal vibration explains the low coefficient of friction of mixtures containing the higher molecular weight saturated fatty acids Certain oxidation products of mineral lubricating oils are believed to be multipolar, and to them is due the elimination of the friction/temperature rise normally characteristic of non oxidised mineral lubricating oils If, however, asphalt is formed and deposited on the bearing surfaces as a result of the oxidisation, then an increase in the coefficient of static friction is likely to occur

Systematic Displacements of Lines in Stellar Spectra The radial velocity of a star as determined from the line displacements in its spectrum is found to depend slightly on the lines chosen for measurement The lines of different elements give different results, though in general these differential effects are only very small They may be caused by the influence of interstellar matter or by conditions in the stars themselves The latter cause of the effect has been studied by Adams and McCormack (*Astrophys J.*, 81, 119, 1935) in the case of nine stars of different types, all of which are sufficiently near to eliminate the effect of interstellar absorption The chief lines affected are the H and K lines of calcium, the sodium D lines and a pair of Al I lines, all of which give systematic differences of the order of −5 km/sec from the normal stellar lines It is suggested that the hypothesis of a gradually expanding envelope surrounding the star affords the best explanation of these results Three of the stars (including γ Cygni) are exceptionally interesting The neutral Fe lines give larger results than those from ionised Fe, and Ce II gives larger values still In such cases the hypothesis of radial convection currents affecting lines of different levels differently seems to be the only adequate explanation

Iron and Steel Welding

THE enormous change in the general outlook on welding which has taken place during the last twelve or fifteen years was never so well exemplified as by the attendance of some nine hundred persons at the first meeting of the symposium on the welding of iron and steel organised by the Iron and Steel Institute with the co-operation of fifteen other scientific and technical societies, and held at the Institution of Civil Engineers on May 2–3. Sir Harold Carpenter presided, and pointed out that the whole question of welding had been raised by Dr. H. J. Gough for the consideration of the Department of Scientific and Industrial Research.

The object of the symposium was of a two-fold character. It was designed in the first place, and mainly, to discover what is now known, and in the second place to map out fields of work for future development. Although welding is still in large measure an empirical art, a considerable amount of fundamental scientific work is now being done, and the results of this have been brought together in a collection of papers which represents by far the most important and comprehensive collection of information on the welding of the ferrous metals which has ever been made. The papers were divided into a series of groups, of which the first dealt with present-day practice and problems connected with welding in the engineering industries. Shipbuilding, bridge and structural engineering, railway material and pressure vessels, formed one sub-section of this group, the other dealing with the aeronautical and automobile industries, the production of chain, the electrical, heavy engineering and machinery industries and the welding of iron and steel castings and of wrought iron.

Group 2 was concerned with the practice and technique of welding, including the apparatus and plant required. The metallurgy of welding, and the questions of specifications, inspection and testing formed Groups 3 and 4. It will come as a surprise to many to discover how much real research is being done, and how fundamental are the advances which are being made, at any rate in certain directions.

From the various papers and discussions certain suggestions emerge regarding the lines on which future development and research might usefully proceed. These include:

(1) The development of plant for electric welding in which the current is automatically adjustable to suit the rate of deposit, together with the necessary control of the arc.

(2) Despite the work which has already been done, there are still very considerable gaps and discrepancies in our information regarding the factors which affect the fatigue resistance of all types of welded joints, particularly in comparison with similar solid, bolted or riveted constructions, and extensive research work on this point is most essential.

(3) The investigation of the effect on the fatigue strength of various types of treatment and electrodes and the comparative influence of alternating and direct current.

(4) The development of forms of welded construction which are based on a real knowledge of the fatigue properties of the welds for dynamically loaded structures (such as bridges).

(5) Work on the welding of the high carbon and alloy steels.

(6) Work on non-destructive methods of testing welded joints.

No aspect of welding, so far as it is applied to iron and steel, was omitted from this highly successful symposium. The most grateful thanks of producers and users of welded structures are due to those responsible for the meeting on one hand, and the authors of the papers on the other. The only note of a critical nature which can possibly be struck is the fact that the material presented was of such enormous dimensions that the time available for its discussion was inevitably greatly restricted. A further discussion of this material at some future date would form a fitting corollary to the meeting already held.

F. C. T.

Royal Observatory, Greenwich

ANNUAL VISITATION

THE Astronomer Royal read his report to the Board of Visitors of the Royal Observatory, Greenwich, on the occasion of the annual visitation of the Observatory on June 1.

The construction of the new reversible transit circle has been completed by Messrs. Cooke, Troughton and Simms, Ltd., and the instrument is undergoing final tests. The construction of the two glass circles of 28 inches diameter, and the etching of divisions spaced at intervals of 5 minutes of arc have been carried out successfully. When completed, the new transit circle will be housed in the Christie enclosure next the Yapp 36-inch reflector. A contract for a slit spectrograph for use with the latter telescope has been placed with Messrs. Adam Hilger, Ltd. This spectrograph is designed for use with one or three prisms at will, the optical parts being made from ultra-violet glass giving good transmission down to 3500 A.

During the year, 9,576 transit observations were made, including 130 observations of the sun and 94 of the moon. The observations of the moon continue to show a decrease in the correction to the longitude given by Brown's Tables, which were introduced into the *Nautical Almanac* in 1923. Nova Herculis was observed on the meridian six times above pole and twice below pole. The position for 1935·0 is α $18^h\ 5^m\ 39{\cdot}85^s$, δ $+45°\ 50'\ 54{\cdot}2''$ (Epoch 1934·99). 42 plates were exposed on Nova Herculis in the slitless spectrograph attached to the Yapp 36-inch equatorial reflector. All these have been calibrated for photometry, and where possible a comparison star has been included. These plates will provide material for the study of the distribution of energy throughout the spectrum. In addition, work has been carried out with the new telescope on the programme of colour temperature work

The spectrohelioscope at Greenwich was used on 179 days. A photometer has been added to the instrument in such a way that the intensities of prominences and bright patches on the solar disc can be measured in terms of the brightness of the undisturbed disc in wave-lengths outside the absorption line concerned Measures of prominences have been made both in Hα and Hβ Work on the intensities of the Fraunhofer lines has been commenced A hut has been built in the Christie enclosure, in which a 16-inch cœlostat has been mounted Sunlight is fed into the basement below the 36 inch equatorial, where it is analysed by a 4 inch concave grating

Magnetic observations have been carried out at Abinger throughout the year The mean values of the magnetic elements for the year 1934 are as follows

Declination,	W	11° 41 1′
Inclination,		66° 39 7′
Horizontal Intensity,		0 18533
Vertical Intensity,		0 42955

Some innovations have been introduced with the meteorological observations Regular observations of the amount of solid matter suspended in the air were commenced on July 1, 1934 In November last, the worst month, a mean weight of 178 mgm of solid impurity was found in each 100 cubic metres of air Compared with the figures recently published for the previous year at other stations, it would appear that the pollution at Greenwich is fully as great as that at any London station, and is not on the average surpassed by any reporting station in Britain, although in Central Glasgow the pollution is worse at the worst times of the day The gaseous pollution of the atmosphere by sulphur dioxide has also been measured daily from January 1, 1935

The mean temperature for the year was 51·9°, which is 2 4° higher than the average for 1841–1915. There were 79 entirely sunless days, and only 39 entirely cloudless nights, that is, nights on which Polaris left an unbroken trace on the night sky camera

A number of improvements have been introduced in the detailed working of the observations for time with the small reversible transit circle Three observers are employed, instead of one, and the observations are corrected for personal equation to the mean of three observers (It is hoped shortly to construct a personal equation machine and obtain absolute personalities) Again, the chronograph and relay system has been brought up to date, and an oscillograph is now used to determine lags in the reception of wireless signals The accordance between Greenwich time and that sent out by foreign observatories is now much closer than was the case a few years ago The mean difference for 1934 between Greenwich and Paris is −0 018^s, and that between Greenwich and Nauen is +0 013^s, the sign + meaning late on Greenwich

During the past year, Mr. Furner, assistant, retired after forty-six years' service, and Mr Blackwell was appointed junior assistant

Concluding his report, the Astronomer Royal referred to the atmospheric pollution, which hampers astronomical work Silvered mirrors and circles tarnish rapidly, and soot and grit are deposited A further difficulty is due to the increasing brightness of the sky at night, which results from the use of mercury lamps for street lighting Photographic work with rapid plates at low altitudes in the sky is impossible in certain directions in which the new lighting is extensively used, and representations have been made to the Greenwich Borough Council on the subject of street lighting

R v d R W

Alchemy and Music

THE first combined meeting of the Chemical and Musical Societies in the history of the ancient University of St. Andrews was held in the Chemistry Lecture Theatre of the United College, St Andrews, on April 24, when Prof John Read, professor of chemistry, delivered an illustrated lecture under the title "The Frankfurt Emblems . a Research in 17th Century Alchemy" The culminating event of the evening was the singing, possibly for the first time in three hundred years, of some unique alchemical music which Prof. Read encountered some time ago in his alchemical studies, and which has formed the subject of a recent research by Mr F H Sawyer, lecturer in music in the University of St Andrews

Alchemy, said Prof. Read, has been variously defined as the pretended art of transmuting base metals into gold, as the chemistry of the Middle Ages, and so forth ; but in its broadest aspect it was a system of philosophy which claimed to penetrate the mystery of life as well as the formation of inanimate substances. Like modern science, alchemy had its theories, notably the theory of the four elements, with the allied conception of the Philosopher's Stone, and the sulphur-mercury theory of the constitution of metals. Alchemical theory, however, like alchemical symbolism, is a complex and intricate subject, rendered even more difficult by its protean character of change The age of alchemy extended approximately from the early years of the Christian era until the end of the seventeenth century

Among many features of interest in the declining years of alchemy are the piquant illustrations, so racy of the alchemical soil of the seventeenth century The Twelve Keys of the mysterious Basil Valentine, in particular, were handled repeatedly by new artists, who provided them with an honoured place in alchemical publications of this time Each of the Keys consists of an emblem with an allegorical description.

Judging from the age-long popularity of Ben Jonson's play, "The Alchemist", which was first produced in 1610, there was a considerable public throughout the seventeenth century for attractive expositions of alchemy Frequenters of the playhouses of those days were familiar with that technical language of contemporary alchemy and astrology which is so much 'heathen Greek' to the modern playgoer. Thus, the production of titillating alchemical works, abounding in pictorial illustrations, came probably as a response to a wide demand

The first issue of the Basilian emblems appears to have been made from Frankfort , and other notable alchemical works with similar pictorial embellishments were published, either in their original or later editions, from this famous centre of early book illustrations There was method in this apparent madness of obscure expression, as Basil Valentine remarked, the obscurity of expression was imperative because the substance of the magic Philosopher's gold-making Stone was within reach of everyone, "and there is no other way of keeping up the divinely ordained difference between rich and poor" If alchemy had survived, remarked Prof. Read, it would have become political

Certain works published at, or near, Frankfort during the seventeenth century, largely under the name of Michael Maier, are rich in such allegorical illustrations, which Prof Read terms for convenience "the Frankfurt Emblems" This Michael Maier was a very remarkable man Besides being a musical alchemist, he became physician and private secretary to the Emperor Rudolph II at Prague, and apparently occupied a high position in the Society of Rosicrucians, or Brethren of the Rosy Cross The publishing firm of Lucas Jennis, of Frankfort, took a prominent part in issuing the works in question, several of which were reviewed in some detail by Prof Read. The emblems were often provided with a Latin epigram, together with a cryptic title and a discourse in the same language "Atalanta Fugiens" ("Atalanta Fleeing"), published by Michael Maier at Oppenheim in 1618, contains fifty such epigrams set to music by the versatile author These so-called 'fugues' are in reality rounds or part-songs for three voices, bearing a marked general resemblance to the well-known, but less dignified, "Three Blind Mice" In allusion to the classical legend of Atalanta and the golden apples, the three parts are quaintly termed "Atalanta, or the Fleeing Voice", "Hippomenes, or the Pursuing Voice", and "The Apple in the Path, or the Delaying Voice"

At the end of Prof Read's lecture, Mr Sawyer, who has made a detailed study of this unique alchemical music, explained its construction and characteristics, after which some of the canons were sung under his direction by members of the St Andrews University Musical Society It is to be presumed that these 'incantations' were intended to be sung at critical moments during the concoction of the Philosopher's Stone, such operations being directed also by prayer and astrological influences In one of the 'fugues', for example, the Stone is likened unto coral, and the epigram opens in the following words

Planta maris vegetans Siculi sub fluctibus uda
Ramos sub tepidis multiplicavit aquis

Or, in English, "The plant of the sea, flourishing moist under Sicilian waves, has multiplied its branches beneath the warm waters " Another 'fugue' takes as its theme the thesis that "Fire loves not gold-making but gold". The music had a quaint and appealing quality which seemed to accord with its esoteric purpose.

Prof Read's illustrative lantern slides, made from the original engravings, included a contemporary representation (1609) of an alchemical laboratory, displaying a selection of musical instruments among the stills and furnaces, with an attached legend stating that "music disperses sadness and malignant spirits".

University and Educational Intelligence

CAMBRIDGE —It is announced that the Museum of Zoology will shortly benefit from the bequest of the late W. D. D Crotch. The capital passing to the University is about £6,000, and a Grace recommending that a new endowment be added to the Crotch Fund, created out of the bequest of his brother, the late G R Crotch, will be submitted to the Regent House

Mr J. T Saunders, of Christ's College, has been appointed a member of the Freshwater Biological Association of the British Empire.

The Gordon Wigan Prize in chemistry for 1934 has been awarded to J E Carruthers, of Emmanuel College, for a dissertation entitled "The Photo-oxidation of Gaseous Formaldehyde"

Prof O T Jones has been appointed to represent the University on July 3 and the following days at the opening of the new Museum of Practical Geology and at the celebration of the centenary of the Geological Survey of Great Britain

The following representatives of the University at conferences abroad have been appointed —Prof. A C Seward, Master of Downing, professor of botany, at the Botanical Congress, Amsterdam, next September, Prof E H Minns, Disney professor of archæology, and Mr L C. G Clarke, curator of Museum of Archæology and Ethnology, at the tercentenary of Peter Pazmany University, Budapest, next September; and Prof G H F Nuttall, emeritus professor of biology, at the tercentenary of the French Academy this month

LONDON —The Court has received gifts towards the Ceremonial Hall to be built on the University site in Bloomsbury from the Worshipful Companies of Needlemakers, Carmen and Spectacle Makers The City Corporation has made a grant of £5,000 (spread over five years) to Birkbeck College towards the new College buildings also to be erected on the University site in Bloomsbury. The Chadwick Trustees have renewed their grant of £200 a year for three years in aid of the Edwin Chadwick Department of Municipal Engineering and Hygiene at University College, and Messrs Bovril, Ltd, have instituted at King's College two research studentships in physiology at £350 a year, and will defray in addition the cost of the special materials, apparatus and assistance needed

The Principal of the University of London announces, in his report on the work of the University during 1934–35, that the first block of the buildings in Bloomsbury, of which the foundation stone was laid by His Majesty the King two years ago, should be ready for occupation next year. This block is to contain the Senate House, administrative offices and part of the library Presumably, therefore, next year will see the removal of the University's home from South Kensington, where it has been sheltered for so many years by the Imperial Institute Towards the finance of the great building scheme the local authorities are contributing sums amounting in the aggregate to £700,000. Gifts promised by the City of London Corporation and forty-six of the City Companies towards the cost of the Great Hall reach a total of £174,000, while the Goldsmiths' Company is giving £50,000 towards the new building for the Goldsmiths' Library. Among many other benefactions mentioned in the report is an undertaking by the Carnegie Corporation to provide 22,000 dollars a year for three years for the Institute of Education, to aid in the development of the Institute's relations with students from the Dominions and Colonies, this is to be used for short-period fellowships for students from the Dominions and for payment of a university teacher from the Dominions to act as "Adviser to Overseas Students". An interesting and important development on the 'external' side of the University concerns the recognition of colleges for the purpose of the external degree in engineering. As external candidates will in future have to submit course work carried out in an approved institution, colleges in various parts of Great Britain have applied for, and forty-two have already obtained, approval for this purpose. Certain overseas colleges are contemplating similar action.

OXFORD.—Mr. T. W. Chaundy has been reappointed lecturer in mathematics for five years from October 1. Mr. C. N. Hinshelwood, Dr. A. S. Russell and Mr. H. J. George have been appointed, or reappointed, lecturers in chemistry for the same period.

Dr. Donald Pollock has undertaken to provide £500 a year from October 1 towards the stipend of the Donald Pollock reader in engineering science, a new readership.

Congregation on May 28 recorded its thanks to the Czechoslovak Government for its loan six months ago, for three years, of 1,636 mgm. of radium for use in the Clarendon Laboratory.

Degrees of D.C.L., *honoris causa*, will be conferred on June 26 on Lord Bledisloe, Sir Herbert Samuel and Sir John Reith, and the degree of D.Sc. on Prof. Peter Debye.

The Romanes Lecture on "Then and Now or the Changes of the Last Fifty Years" will be given on June 14 by Prof. Gilbert Murray.

Science News a Century Ago

Death of Edward Troughton

Edward Troughton, the famous Fleet Street instrument maker, whose name is still borne by the firm of Cooke, Troughton and Simms, Ltd., died on June 12, 1835. Like the other eighteenth century mechanicians Sharp, Graham, Bird and Ramsden, Troughton came from the north, being born in Corney, Cumberland, in 1753. At first brought up to farming, at seventeen years of age he became an apprentice to his elder brother John in London, and the two for a short time were partners as mechanicians. On his brother's death, Troughton carried on the business alone until 1826, when he took into partnership William Simms (1793–1860). So early as 1778, Troughton had introduced a new method of graduating arcs of circles, which was eventually to lead to the award to him of the Copley Medal, and he gradually gained a reputation as an instrument maker second to none. Instruments of his were erected in observatories at Paris, the Cape, St. Helena, Madras, Cracow, Cadiz, Brussels, Edinburgh, Cambridge and Greenwich.

A man of simple and frugal habits, Troughton was never married, and towards the end of his life, it is said, he was seldom absent from his dingy parlour at 136 Fleet Street, London, where he sat with a huge ear trumpet at hand, wearing clothes stained with snuff, and a soiled wig. Elected fellow of the Royal Society in 1810, he was an original member of the Royal Astronomical Society, and a marble bust of him by Chantrey, subscribed for by his friends, was placed in the Royal Observatory, Greenwich. His grave is in Kensal Green Cemetery.

Wilkinson on Gunpowder

According to the *Athenæum* of June 20, 1835, the Friday evening meetings of the Royal Institution for the summer closed on June 12 with a lecture on the history and manufacture of gunpowder by Mr. Henry Wilkinson, who had on several former occasions delivered lectures on warlike machines of the ancients, etc. Mr. Wilkinson was of opinion that gunpowder was known to the ancients, and that it was highly probable that Alexander the Great actually met with gunpowder and firearms in India. He quoted the Gentoo laws to show that they contain a prohibition of gunpowder and firearms, and from this and other authorities referred to, he seemed to be of opinion that gunpowder had been known in China and Hindustan, far beyond all period of investigation. His lecture was accompanied by some interesting experiments on the action of fulminating powders on gunpowder.

Progress on the London and Greenwich Railway

In the *Mechanics Magazine* of June 13, 1835, is a communication from a correspondent who wrote: "On Monday last a number of shareholders and directors of this undertaking met at the works near the Blue Anchor-road to witness the experimental running of the Company's locomotive engine 'The Royal William'. A distance of one mile was performed in about four minutes. A glass of water, filled to the brim, was placed on the block holding the rail, to ascertain the degree of vibration, when the engine, with the tender with water and coal, and several passengers, the whole train weighing at least 14 tons, passed along. Not a drop of water was spilled, nor was any vibration perceptible. Persons who stood under the arches when the engine passed over, were astonished to find that the noise was no greater than what would be occasioned by the passing of a hackney coach."

Airy and the Royal Observatory, Greenwich

In the latter part of 1834, Airy, then at Cambridge, had been asked whether he would accept the office of Astronomer Royal, but a change of Ministry caused a delay in the negotiations. The various steps which finally led to his appointment are given in his autobiographical notes for 1835. "The Ministry," he wrote, "had again been changed in the spring, and the Whigs were again in power. On June 11th Lord Auckland, who was again First Lord of the Admiralty (as last year) again wrote to me to offer me the office of Astronomer Royal, or to request my suggestions on the filling up of the office. On June 15th I wrote my first reply, and on June 17th wrote to accept it. On June 18th Lord Auckland acknowledges, and on June 22nd the King approved." On August 13 Airy had a meeting with Lord Auckland and Mr. Charles Wood, the Secretary of the Admiralty. "At this meeting Lord Auckland and Mr. Wood expressed their feeling, that the Observatory had fallen into such a state of disrepute that the whole establishment ought to be cleared out. I represented that I could make it efficient with a good First Assistant, and the other Assistants were kept. But the establishment was in a queer state . . . ." Airy took charge of the Observatory in October 1835, having for his first assistant Robert Main.

Societies and Academies

PARIS

Academy of Sciences, April 24 (*C R.*, 200, 1445–1500). The president announced the death of Louis Jobin PAUL LANGEVIN Concerning an experiment suggested by M Dufour RICHARD FOSSE, PAUL DE GRAEVE and PAUL EMILE THOMAS. The identification of small quantities of formol The method proposed is based on the insoluble compound formed with naphthol, namely, di-naphtholmethane A precipitate is formed with 0 1 mgm of formol at a dilution of 1/100,000 GEORGES CLAUDE The campaign of the *Tunisie* LOUIS LÉGER and MLLE MARCELLE GAUTHIER. The spore of the Harpellaceæ, parasitic fungi of insects J PRZYBOROWSKI and H WILENSKI The errors of the first and second category in the verification of hypotheses concerning Poisson's law STANISLAS GOLAB Transformations by polar reciprocals in Finsler's geometry PIERRE LEJAY and TSANG HUNG-CHI. The interpretation of the observations of the value of gravity carried out in the centre of China. The anomalies given in earlier communications are summarised in a chart JEAN J TRILLAT and HANS MOTZ The errors of interpretation in electronic diagrams of organic substances Doubt is thrown on results hitherto obtained with electronic analysis, on account of the ease with which the surfaces examined become covered with a greasy film The conditions must be such that the possibility of formation of superficial fatty films is eliminated PIERRE JOLIBOIS A new experiment in electrolysis RENÉ BARTHELEMY Cathodic television with automatic synchronism ROBERT BLONDEL and PAUL LAFFITTE The constitution of the antimony-tin-zinc alloys. OMER LIÉVIN and JEAN HERMAN The autoxidation of the hydroxides of iron, manganese and cobalt. MME MADELEINE DELEPINE-TARD The bromo-dipyridine derivatives of iridium MARCEL GODCHOT and MLLE. GERMAINE CAUQUIL The action of organo magnesium compounds on ethyl 1-aminocyclohexanecarbonate. RAYMOND PAUL Methods of preparation of the α-alkylfuranes MLLE SIMONNE CAILLÈRE The specific characters of bowlingite From the chemical analysis, thermal analysis, and X-ray diagrams, it is concluded that bowlingite is a fibrous form of saponite, its chemical composition being between those of montmorillonites and chlorites. JEAN ORCEL and PIERRE FASTRÉ. The curves of dispersion of standards of reflecting power utilisable in the microscopic study of metallic minerals MARCEL ROUBAULT. The chemico-mineralogical characters of the tertiary eruptive rocks of Kabylie de Collo (Department de Constantine, Algeria). ANDRÉ DUPARQUE · The petrographic characters of the Permian coals of the Belgian Congo. Both the macroscopic and microscopic characters of the Permian coals from the Belgian Congo correspond closely with those of the Westphalian bituminous coals PIERRE GRASSÉ and MLLE ALICE FAURE · The reproduction of the parabasal apparatus of *Trichomonas caviæ* MME. VÉRA DANTCHAKOFF · The factors determining the position of the gonads in the fowl

AMSTERDAM

Royal Academy (*Proc.*, 38, No 3, February 23, 1935). C. WINKLER: Researches on the hind brain Loss of the cerebral hemispheres is followed by atrophy of the apical convolutions of the hind brain. J. H. GISOLF and P. ZEEMAN: Intensity measurements with a reflection echelon. Method for determining the relative intensities of hyperfine components of a spectral line A A NIJLAND: Mean light-curves of long-period variables. (22) *R Draconis*. The light varies with a period of 244 days and an amplitude of 5 40 magnitudes F. M JAEGER and J A VAN DIJK Complex salts of α α′-dipyridyl with zinc and cadmium (2) Crystallographic data on the complex salts formed by α α′-dipyridyl with various zinc and cadmium salts F M JAEGER and J BEINTEMA Symmetry and structure of the crystals of the hydrochlorides of triamino triethylamine An X-ray examination of the cubic $N(C_2H_4NH_3Cl)_3$ and the hexagonal $N(C_2H_4NH_3Cl)_3HCl + H_2O$ A H BLAAUW Growth of the iris bulb after various summer treatments (1) An investigation of the best method of treatment of bulbs of various sizes on behalf of the bulb cultivator P J BOUMA and G HELLER. Outlines of a general theory of the colour metric (3) H H BRONS Perturbations in the $\Sigma^2 \rightarrow \Sigma^2$ bands of N_2^+ Measurements on the (5, 7) and (3, 5) bands in which perturbations occur in the upper state V HLAVATÝ Conformal geometry (1) Gauge invariant connexion G H R VON KOENIGSWALD Preliminary communication on the occurrence of tectites in Java Discovery of tectites in Java at sites of definitely known geological age TH RAVEN New finds of quaternary mammals in the Netherlands (2) *Equus caballus*, L, *E robustus*, Pomel, *Asinus fossilis*, Owen, and *Megaceros euryceros latifrons*, subsp nov MISS H DE BEER Morphological significance of the thorns of the different species of *Citrus* The thorn at the side of the bud is analogous to a branch and not to a leaf J. P KLEIWEG DE ZWAAN The connexion between head and face measurements among the Minangkabau Malays of Central Sumatra C E BENJAMINS, H A E v DISHOECK and J. L M GERMAN · Studies on the active substance of grass pollen (1) Activation of a small molecular weight active group by colloidal substances. H. ALDERSHOFF · Successful attempts to transmit to monkeys by cutaneous inoculation the poliomyelitis and encephalitis post-vaccinalis occurring in Holland It is suggested that the cause of post-vaccinal encephalitis is not the vaccine virus but some other, myelo-encephalitogenic virus which enters the scarifications during or after vaccination. H. DE JONG, D J. KOK, A. GEESINK and F. J. NIEUWENHUYZEN. Experimental catatonia, produced by auto-intoxication (1). Experimental catatonia after artificial obstruction of the lumen of the intestine Ligature of the intestines of dogs produced catatonia through auto-intoxication A. DE BUCK and N H SWELLENGREBEL: Seasonal longevity of *Anopheles maculipennis* in Holland with reference to their ability to act as malarial vectors G. GIESBERGER: Correction to a paper on saliva-, pancreas- and Aspergillus-amylase (Taka diastase) as a mixture of two kinds of amylases. J. BONNER. Some colloidal properties of the pectins. The preparation of pure sodium pectate, ash-free pectic acid, a pectinic acid and a sodium pectinate and the determination of some of their colloidal properties.

GENEVA

Society of Physics and Natural History, March 7. M GYSIN: The copper minerals of Kinsenda (Belgian Congo) (1). The bornite-chalcopyrite associations The copper mineral of Kinsenda contains patches of chalcopyrite and bornite A part of the bornite contains fine lamellar inclusions of chalcopyrite arranged in the bornite planes of cleavage (100), an association resulting from the decomposition of a bornite-chalcopyrite solid solution formed at a high temperature and therefore hypogene These complex grains are often associated with compact chalcopyrite, the mutual contacts of these two minerals suggest simultaneous formation There are also small lodes of supergene bornite in the chalcopyrite regions E Briner, B Susz and E Perrottet Chemical reactivities and Raman spectra in the eugenol group and the vanillins The Raman spectra of the substances of this group have been determined from the point of view of relationship with their chemical activities. E Guyenot and Mme J Duszynska Sterility and virility of pituitary origin in the guinea pig The study of about twenty sterile and masculinised females has shown alterations of the ovary accompanied with thyroid hyperactivity, of hypertrophy of the suprarenal capsules and of neoplasmic productions which appear to arise from a disturbance of the secretion of the anterior pituitary P Rossier (1) The variation of the relative width of the lines of stellar hydrogen with the spectral type (2) Variation of the relative width of the lines of calcium and of stellar hydrogen as a function of the spectral type (3) The ratio of the widths of the two lines $H\varepsilon + H$ and K in stellar spectrograms (4) The spectral type of some stars of class *A* A Amstutz and A Borloz. The synthesis of the emerald The authors had deposited a sealed letter at the meeting of the Society on May 4, 1933 The letter was opened and read It dealt with the synthesis of the emerald in a suitable apparatus by melting the oxides of aluminium and silicon with beryllium fluoride as a flux Léon W Collet and Arnold Lillie (1) The internal Prealps between the River Arve and the River Giffre The authors have discovered that the internal Prealps between the Rivers Arve and Giffre have much greater extent than indicated in the present geological map (2) The existence of lacustrine limestones in the Nummulitic of the Col de Bostan. The discovery of lacustrine beds of Lutetian age at the Dents Blanches de Champéry permits a correlation with similar beds at the Dents de Morcles Ed Parejas and E Molly Study of some Tchertcher (Abyssinia) limestones Among the Jurassic limestones collected by E Molly are pseudo-oolitic limestones containing Crinoids, Echinoidea, Corals, Rotalides, Miliolides and Textularia These formations, the facies of which resembles that of certain limestones of the upper Jurassic and of the Swiss Jura Berrasian, must have been formed under the same conditions as the latter A fragment of Nerine shows some affinities with *N. Desvoidyi* R Verniory: The Mesozoic of the external Prealps (Faucigny hills). F. Batelli, Don Zimmet and P. Gazel · The action of cardoon extract on the heart Don Zimmet, L. Janco and B Ghinsberg The action of extract of striated muscle on the development of the egg of the frog (*Rana temporaria*).

WASHINGTON, D C

National Academy of Sciences (*Proc*, 21, 69–141, Feb 12) H J Muller and S M. Gershenson: Inert regions of chromosomes as the temporary products of individual genes. It is suggested that the inert regions of the *X*- and *Y*-chromosomes consist of non-genic material derived from a very few specific active genes, rather than of a row of degenerated genes. Breakages occur in such regions more readily than between genes in the so-called active region. W L Doyle and C W Metz Observations on the structure of living salivary gland chromosomes in *Sciara* In body fluid or isotonic salt solution, these giant chromosomes are invisible, they are represented by optically empty tracts, occupying so much as 80–90 per cent of the nuclear content Shrinkage occurs and bands appear on fixation In the normal living state, the segments representing the chromioles may be disc-like and the granules thought to be genes may appear as the result of fixation or other injury Theodora Nussman Salmon and Albert F Blakeslee Genetics of sensory thresholds variations within single individuals in taste sensitivity for *PTC* (phenyl thiocarbamide) The taste threshold for this compound varies considerably from individual to individual and even in most individuals during the course of a day and from day to day This confirms a suggestion that refined methods are unnecessary in determining taste thresholds Albert F Blakeslee and Theodora Nussman Salmon Genetics of sensory thresholds · individual taste reactions for different substances Taste reactions to 17 substances were investigated for 47 individuals It is concluded that the correlation between acuteness of taste for two substances, though generally positive, is low, and there are many exceptions No two of the 47 subjects were alike in all their thresholds Donald F Jones: Somatic segregation due to hemizygous and missing genes and its bearing on the problem of atypical growth The term hemizygous has been given to an unpaired gene and is here applied to autosomic genes which have lost the other member of the pair Mosaics and other forms of abnormal growth may be due to such losses of chromosome material G D Birkhoff and M R Hestenes (1) Generalised minimax principle in the calculus of variations (2) Natural isoperimetric conditions in the calculus of variations M H Stone Subsumption of the theory of Boolean algebras under the theory of rings N Jacobson and O Taussky Locally compact rings P W Bridgman Electrical resistances and volume changes up to 20,000 kgm /cm ^{2} The development of new steels has made it possible to extend the pressure range from 12,000 to 20,000 kgm /cm ^{2} The resistance of black phosphorus decreases rapidly, reaching 0 0069 of its value at atmospheric pressure at 20,000 kgm /cm ^{2}; there is probably a minimum at 23,000 kgm, followed by an increase, as with the alkali metals The temperature coefficient changes sign at 12,000 kgm, becoming positive and eventually reaching three quarters of the value characteristic of most pure metals Tellurium gives similar results. Copper sulphide, however, shows a decrease of resistance of only 11 per cent, and there are irreversible effects Pressure-volume temperature measurements for lithium, sodium and potassium suggest a fundamental change in the metal at high pressure J O Hirschfelder and E Wigner Separation of rotational co-ordinates from the Schrödinger equation for *N* particles Chester Stock: *Plesiomiacis*, a new creodont from the Sespe Upper Eocene, California L R Blinks, R D Rhodes and G A. McCallum: Protoplasmic potentials in *Halicystis*. (5) The reversal of potential by unbalanced NaCl W. J. V. Osterhout How do electrolytes enter the cell? A discussion, from the point of view of physical chemistry, of experiments on the marine alga *Valonia* suggests that, whereas there is little penetration by ammonium ions, ammonia and its hydroxide enter freely, apparently by combining with an acidic constituent (HX) of the protoplasm Strong electrolytes may possibly also enter by combining with one or more constituents of the protoplasm A A ABRAMOWITZ. (1) Degeneration of xanthophores in *Fundulus majalis* Over blue or white backgrounds, the xanthophores are in a concentrated state and there is a decrease up to 50 per cent in the number of carotenoid cells, over yellow or black backgrounds, where the pigment is dispersed throughout the cells, there is a small increase in the number of cells (2) Regeneration of chromatophore nerves. A cut across the fin rays in the tail of the killifish, *Fundulus heteroclitus*, produces a persistent dark band beyond the cut due to denervation of the pigment cells Rate of regeneration of these autonomic pigment motor fibres can be studied fairly accurately by keeping the fish on a dark background for a fortnight and then exposing them for five minutes daily to a white background and estimating the progressive decrease of the dark band

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, June 9

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4 30 — Miss M R J Edwards "Whales and other Sea Animals"

Wednesday, June 12

RESEARCH DEFENCE SOCIETY, at 3 - (at the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1) Annual General Meeting

Sir Frederick Hobday "The Relief of Animal Suffering" (Ninth Stephen Paget Memorial Lecture)

BRITISH SCIENCE GUILD, at 4 30 — (at the Royal Society of Arts, John Street, Adelphi, London, W C 2) Annual General Meeting

J Davidson Pratt "Gas Defence"

Thursday, June 13

ROYAL ASIATIC SOCIETY, at 4 30.—Miss D A E Garrod "In Search of Stone Age Man in the Near East"

ST MARY'S HOSPITAL, London, at 5 —J Henderson Smith "Virus Disease in Plants a Comparison with Virus Disease in Animals" *

Friday, June 14

ROYAL ASTRONOMICAL SOCIETY, at 3 —Dr H N Russell "The Analysis of Spectra and its Application in Astronomy" (George Darwin Lecture)

Official Publications Received

GREAT BRITAIN AND IRELAND

Education (Scotland) Report for the Year 1934 by the Director on the Royal Scottish Museum, Edinburgh Pp 14 (Edinburgh Royal Scottish Museum)

Royal Observatory, Edinburgh Forty-fifth Annual Report of the Astronomer Royal for Scotland, 1934 Pp 8 (Edinburgh and London H.M Stationery Office.) 2*d* net

Institute for Research in Agricultural Engineering University of Oxford. Farm and Machine Vol 2 Comprising the Report of the Institute for the Year ended September 1934, and Miscellaneous Papers on Agricultural Engineering. Pp. 98+8 plates (Oxford Institute for Research in Agricultural Engineering.) 2*s* 6*d*.

Armstrong College, Newcastle-upon-Tyne Standing Committee for Research Report, Session 1933-1934 Pp 45 (Newcastle-upon-Tyne. Armstrong College)

Air Ministry: Aeronautical Research Committee Reports and Memoranda. No. 1629 (T. 3486) · Accelerators of Aeroplanes in Vertical Air Currents, Part 2 By H R. Fisher Pp 16+8 plates. (London H.M. Stationery Office) 1*s* net

Board of Education. Educational Pamphlets, No 103 Education for the Printing and Allied Trades. Pp. 111. (London H.M Stationery Office.) 2*s*. net.

The British Science Guild Engineers' Study Group on Economics First Interim Report on Schemes and Proposals for Economic and Social Reforms Pp 44 (London British Science Guild) 1*s*

Iodine for Livestock By Frank Ewart Corrie Pp 82+7 plates (London Nitrate Corporation of Chile, Ltd) Free

Patents, Designs and Trade Marks Fifty-second Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1934 Pp 24 (London H M Stationery Office) 4*d* net

The Museums Association Report of the Council for Year 1st April 1934 to 31st March 1935 Pp. 12 (London. Museums Association)

British Chemical Abstracts Issued by the Bureau of Chemical Abstracts Index 1934 Pp 692 (London British Chemical Abstracts)

OTHER COUNTRIES

Canada Department of Mines Mines Branch Petroleum Fuels in Canada Deliveries for Consumption, Calendar Year 1933 Prepared by John M Casey (No 759) Pp 12 (Ottawa King's Printer) 10 cents

The Imperial Council of Agricultural Research Scientific Monograph, No. 9 Mechanical Cultivation in India, a History of the Large Scale Experiments carried out by Burmah-Shell Oil Storage and Distributing Company of India, Limited By C P G Wade Pp viii+124+12 plates (Delhi Manager of Publications) 3 14 rupees, 6*s* 6*d*

Publications of the Manila Observatory Vol 2, No 5 The Upper Air of Manila By the Rev Charles E Deppermann Pp 29 (Manila Bureau of Printing)

Koninklijke Vereeniging "Koloniaal Instituut", Amsterdam Vier en twintigste Jaarverslag 1934 Pp 109 (Amsterdam Koloniaal Instituut)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Jaarverslag 1934 Pp 27 (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium)

Kungl Svenska Vetenskapsakademiens Handlingar Serien 3 Band 14, No 3 Examen Rosarum Suecìæ Granskning av den Svenska Florans Rosa Former 1 Norrland och Dalarne. Av L P Reinhold Matsson Pp 380 Serien 3, Band 14, No 4 The Longer Trade Cycles By Axel F Enström Pp 24 Serien 3, Band 14, No 5 The Distribution of Stars in the Scutum Region of the Milky Way By Carl Schalén Pp 47 (Stockholm Almquist and Wiksells Boktryckeri A -B)

Government of India Department of Industries and Labour (Public Works Branch) Triennial Review of Irrigation in India 1930–33 Pp 62 (Delhi Manager of Publications) 1 4 rupees, 2*s*

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 87 Orthoptera of the Upper Rio Grande Valley and the adjacent Mountains in Northern New Mexico By Morgan Hebard Pp 45-82 (Philadelphia Academy of Natural Sciences)

Publications de l'Observatoire de Genève Rapport sur les concours de réglage de chronomètres de l année 1934 Pp 25 (Genève Observatoire de Genève)

Astrophysica Norvegica Vol 1, No 4 On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation By Carl Størmer Pp 115–168+17 plates Vol 1, No 5 A Simplified Treatment of some Fluid Oscillations By C L Godske Pp 169–197 (Oslo Jacob Dybwad)

Geological Survey of the Anglo-Egyptian Sudan Bulletin No 2 Water Supplies in the Anglo Egyptian Sudan By G W Grabham Pp 42+5 plates (Khartoum Sudan Bookshop, London Sudan Government Office) 8 P T, 1*s* 8*d*

Forestry Pamphlet No 3 Timber, its Structure, Properties, Seasoning and Preservation Pp 18+5 plates (Trinidad Government Printing Office) 12 cents

The British South Africa Company Publication No 3 Mazoe Citrus Experimental Station, Annual Report for 1933 Pp xviii+92 (Mazoe Mazoe Citrus Experimental Station)

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Observatoire de Paris, Section d'Astrophysique, à Meudon Cartes synoptiques de la chromosphère solaire et Catalogue des filaments de la couche supérieure Vol 1, Fasc 3, Année 1933 Par L D'Azambuja. Pp 34 (Meudon Observatoire de Paris)

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Avebury—the Nation's Responsibility

AN interest in the preservation of areas of natural beauty or historic interest, now widely diffused among the public, affords hope of the success of an attempt which is being made to secure the famous site of Avebury and its immediate neighbourhood in Wiltshire from vandalism once and for all, and to promote its further archæological exploration

Of the importance to the prehistorian of the site at Avebury there can be no question Even in the unlikely contingency that future excavation should bring no additional monuments to light, Avebury as it stands, with its satellites, constitutes one of the most imposing assemblages of the work of prehistoric man, not in Britain alone, but in the whole of Europe The circle itself, with its three rings, is the largest known to exist It covers twenty-nine acres of ground and is surrounded by a rampart and a fosse, now mostly silted up, three quarters of a mile in length An avenue a mile long leads from one side to the remarkable sanctuary on Overton Hill This avenue was marked by standing stones, but many are missing or fallen The missing members are being sought underground by Mr Alexander Keiller, and as they are found are being replaced Even this work of exploratory repair has thrown fresh light on the cultural history of the settlement A similar avenue of like length may have led from the circle in almost exactly the opposite direction This too may prove a guide to future discovery

The remains directly linked with the circle by no means exhaust its archæological context At a distance of a mile to the north-west lies the camp on Windmill Hill, which Mr Keiller's recent excavations have made a *locus classicus* in the annals of archæology, and at the same distance to the south is Silbury Hill, of which the bare statement that it is the largest artificial circular mound in Europe gives little idea of the impressiveness of its height and mass Nearby are the East and West Kennet barrows, the largest long barrows in Britain Both long and round barrows are numerous in the area; and not far away stands Stonehenge.

The mere enumeration of the monuments of the area is a sufficient indication of its pre-eminence in early cultural development, while their size and construction, necessitating the preparation, transport and erection of these great blocks of stone, as well as excavation on a grand scale, must have involved an organisation of labour and an engineering skill such as could have been possible only at a point of concentration of a relatively large population over a considerable period of time It requires little exercise of the imagination and no straining of the facts to see in Avebury a great centre of early tribal and religious activity. Lying on the periphery of European prehistoric culture, it is the meeting place and the goal of lines of ethnic and cultural migration, of which the paths across Europe are now emerging as the result of recent archæological research Already at Avebury and in the neighbourhood, excavation has established a cultural succession in the neolithic and early bronze ages of the third and second millennia before our era, which eventually may afford a clue to the causes which led to this great efflorescence of cultural development and the reason why it should have taken place precisely at this point.

Mr. Ormsby-Gore's appeal on behalf of Avebury, in *The Times* of May 31, is an exceptional measure to meet a difficult situation As a Minister of the Crown and the responsible head of the department which has been entrusted by Parliament with the protection of our ancient monuments, he presses urgently for the co-operation of the public in the preservation and further exploration of this centre of ancient civilisation By his action, the future of Avebury has been raised to the status of a national problem. Normally, the Office of Works does not take action in such matters except on outside representation; nor do its powers to protect ancient monuments under schedule extend, except in certain conditions, to ensuring the preservation and systematic and scientific investigation of the evidence which lies beneath the surface of the ground Hence in the conflict of private ownership and scientific and historic interests, the latter, even in the face of public protest, may go to the wall It is with the object of averting this catastrophe at Avebury that Mr. Ormsby-Gore has intervened to urge the need for immediate powers to control the future of the site.

At present, exact and scientifically assured knowledge of Avebury and its surroundings covers only a small part of the field; and an intensive exploration of a considerable area is essential before anything like a comprehensive view of its development will be possible Mr. Ormsby-Gore, indeed, holds that this investigation is of such moment that it should take precedence of all other schemes; and he couples Avebury with the Roman Wall as being of international importance. Further, he stresses the danger which threatens the character and archæological development of the site through the erection of "haphazard bungalows, petrol pumps, or other less desirable forms of our ephemeral twentieth-century 'development' ".

The danger is acute Mr Ormsby-Gore points out that the Office of Works has effective 'guardianship' only over Silbury, the West Kennet Barrow and the sanctuary on Overton Hill, and although the stones now standing or lying above ground are 'protected' under schedule, the land which everywhere may cover precious evidence of this great neolithic civilisation is in the hands of small landowners, who not unnaturally are desirous of making the most of their opportunities

What is the remedy? Mr. Ormsby-Gore is anxious that the urgent work of conservation and further exploration should proceed forthwith, and suggests the immediate application of a scheme under the Town and Country Planning Act For this it would be necessary to secure joint action on the part of the local authorities of Wiltshire, the owners and the Office of Works itself, as well as the support of "the various public bodies interested in the progress of British archæology" While local bodies in Wiltshire will no doubt be sufficiently public-spirited to lend the weight of their authority, private owners may be less ready to acquiesce if the scheme involves serious interference with their rights to deal with their own property.

Without details it is impossible to say how far this method of procedure is likely to attain adequate preservation of the antiquities in the area and ensure the facilities necessary for future research. Under existing legislation, archæological exploration would seem to be a necessary precedent condition of effective protection, and this will be both a lengthy and a costly business If Avebury is of international importance as Mr Ormsby-Gore maintains—and no archæologist would be prepared to deny this contention—its possession by Great Britain imposes upon the nation a duty not only of maintaining the area in a condition worthy of its character and history, but also the duty of making accessible its full evidential value in the history of European civilisation—in other words, of assuming the responsibility for its exploration. Avebury and its surroundings should be made a national possession and a reserve under Act of Parliament much as is the Yellowstone Park in the United States and a sum should be set aside annually in the provision for the Office of Works for its archæological investigation As the system of farming in Wiltshire is not such as need interfere with the character of the area as a setting of archæological remains rents under Crown holdings would reduce the cost of such a scheme In such a way but scarcely otherwise would this generation carry out to the full its obligation to posterity

Reviews

Vitamin Research

Methodik der Vitaminforschung Von Dr Christian Bomskov Pp xvi+301 (Leipzig Georg Thieme 1935) 24 gold marks

THIS is a book that can be recommended without any hesitation or qualification to all those who are concerned with biological chemical or physical assay of the vitamins So thoroughly has the ground been covered including even those portions of contiguous territory with which too many vitamin assayists seem to be unacquainted that it can be confidently recommended to all who are engaged in any kind of biological assay whatever The introductory pages being concerned with the rearing and maintenance of a healthy animal colony emphasise however briefly *matters of fundamental importance to every* animal laboratory

On this question of an animal colony there is one sentence in the introductory chapter that almost deserves to be printed in letters of gold The author is discussing the spontaneous appearance of diseases in an animal colony and tersely remarks Die beste Prophylaxe ist immer noch die Sauberkeit im Tierstall He gives some interesting tables showing the different stock diets that have been proposed by different investigators and his tables showing the composition of different constituents will save many workers time in looking up figures and making their own calculations It is however curious that when stating the average weight of young animals produced on different diets recorded he makes no distinction between the pure albino rat and the pied or hooded animal, though it is well known to workers in this field that certain strains of the latter may have a growth rate and a final weight 50 per cent greater than those of the former It would obviously be quite unfair for example to condemn diet *A* because it permits in pure albinos less vigorous growth than diet *B* permits in pied albinos

Before directing attention to certain of the author's views and venturing to criticise some minor points it is necessary to point out that this is the only volume available on its subject and has therefore to be judged on its merits without odious comparisons Of the standard books on vitamins we recognise the English survey published by the Medical Research Council and the American Chemical Society s monograph by Sherman and Smith as authoritative and permanent The former lays naturally rather more emphasis on the clinical aspect than the latter which is written by and for chemists between them they give a comprehensive account of known facts and suspicions The vast monograph by Ethel Browning marred by a number of inaccuracies commands respect for its bibliographic completeness as also does the more limited but also more accurate bibliographical Survey of Vitamins published by Wodlinger in 1932 Besides these we have certain specialised books—for example Barnett Sure s Vitamins in Health and Disease Hess s monographs on rickets and scurvy Blunt and Cowan s Ultraviolet Light and Vitamin D in Nutrition —and a number of semi popular expositions but nobody has so far gathered together in one place an account of all the varying techniques employed in vitamin research The excellent series of papers by Jung in the *Zeitschrift fur Vitaminforschung* only occupies 54 pages and is confined to methods of assay in food and pharmaceutical products in Dr Bomskov s much more comprehensive publication all methods proposed by workers of standing have been described in detail and made to some extent the subject of critical consideration One can particularly admire the way Dr Bomskov has managed to produce by September 1934 (the date of his preface) a book that actually takes cognisance of the recommendations made by the Vitamin Conference in June of that year

We might it is true with advantage have had a rather more detailed discussion of the principles involved in vitamin assay Had this been done the curious understatement that in certain circumstances pure bred animals are to be preferred ' could have been made considerably clearer The change in methodology implied by the introduction of standard preparations into vitamin assay should have been discussed explicitly, particularly since some German workers in the field have been amongst the worst sinners in depending upon animal reactions for their units of measurement.

After a general section, occupying 25 pages, there follows the special section of the book, in which every known vitamin is discussed separately In addition to A, D, E, B_1, B_2 and C, the author has thought fit to include a discussion of the "fat-soluble growth vitamin", by which he understands the "Coward factor", though his references also cover the work of Evans and Lepkovsky on the unsaturated fatty acid dietary factor, which is perhaps a rather unfortunate confusion In the water-soluble group he has included, besides B_1 and B_2, the following factors. B_6 (anti-pellagra), extrinsic factor or anti-sprue factor, B_3, B_4, B_5, F (reported by Sure, Kik and Smith, and possibly identical with the flavine factor), Chick and Copping's Y factor, the insoluble factor R of Hunt and Lewis and vitamin H of Gyórgyi, as well as the vitamin C_2 of Bezssonoff and von Euler Besides this miscellaneous collection of vitamins, some of them of distinctly dubious respectability, we find in the last two pages of the book a section entitled "Vitamins of Doubtful Nature", including such things as McCay's trout factor, the anti-paralytic factor of Keenan and colleagues, the growth factors of Mapson, Daggs, Seegers-Smith, Madsen, Norris, and Bethke, with a final allusion to Wesson and Murrell's carbohydrate-exchange regulating factor

The book is throughout profusely exemplified with tables and illustrations, the latter reproduced from original publications in various countries Dr Bomskov has adopted a sound, but rather unusual, course in reproducing most of his tabular matter in its original language, and has been remarkably successful in avoiding printer's errors during the process (A very few, such as "scaily tail", "Osteolin", and so on have been noticed) He has also inserted a number of tables of his own, as for example, the comparative list of vitamin B_1-free diets (p. 170), which includes seventeen variants proposed by twelve different workers or groups of workers

The book is, naturally, concerned predominantly with biological methods of assay, but the author has given an adequate account of such procedures as the chemical evaluation of reducing power, proposed by Tillmanns, Harris and others for assaying vitamin C, and has even included the Reichstein, Haworth and Micheel syntheses of ascorbic acid, for which he has used the configuration put forward by the Birmingham workers and now generally accepted. Again, he has given adequate recognition, following the findings of the 1934 Vitamin Conference, to the spectrophotometric method of assaying vitamin A, and does not overlook Chevallier's ingenious adaptation of this method.

Towards the end of each section on a particular vitamin, short special sections give information as to the requirements and storage of the vitamin in various animals, including man It is interesting to note that the author regards vitamin B_2 as consisting of a flavine growth factor, Gyorgyi's antipellagral B_6, and the extrinsic factor of Castle, a view that we do not think will find general acceptance at the present moment In the general section he also remarks, in passing, that on a particular stock diet of his own, the young animals have such large reserves of vitamin B_2 that they cannot be used for its investigation In view of current controversy, however, his discrimination between the flavines and the anti-pellagral factor seems to be more important than his assignation of the term "B_2" to the former

The book is extremely well served with references, the author has elected to place them at the foot of the pages to which they apply, and to dispense with the usual author index The subject index of twelve pages is perfectly adequate The high quality of Dr Bomskov's work has been ably backed by his publisher, though it is a pity that a book likely to be handled as often as this one should be published in paper covers

A. L. BACHARACH.

The Works of Huygens

Œuvres complètes de Christiaan Huygens, publiées par la Société Hollandaise des Sciences Tome 18 *L'Horloge à pendule ou à balancier de 1666 a 1695, anecdota.* Pp. iv+703. (La Haye Martinus Nijhoff, 1934) n.p.

THE eighteenth volume of the monumental edition of the works of Christiaan Huygens, in course of publication by the Dutch Society of Sciences, appears less interesting than many of its predecessors The reason for this impression does not lie in the value of its contents On the contrary, it is because the greater part of the volume is occupied by the classical work "Horologium Oscillatorium", which alone would have sufficed to establish the enduring fame of its author But this was the mature outcome of years of earlier research; the polished work is not only more familiar, but also the phase of creative effort has an interest which cannot be altogether sustained in a formal textbook, however original.

Huygens went to Paris in 1666, and nearly the whole of the following fifteen years were spent in the French capital. He had been in intimate correspondence with some of the leading founders of the Royal Society, and he took a natural place, and soon a dominant place, in that group of men who, under the encouragement of Colbert and his royal master, founded the Paris Academy of Sciences. What constitutes the greatness of Huygens is the universal character of his outlook and method. His distinction lies at once in observational science, in his mastery of physical manipulation and in natural philosophy. The practical and the theoretical side of things shared his interest. Hence his persistent and fertile efforts to improve the construction of the clock conferred a recognised benefit on mankind. Yet the motive came from the recognition of the clock as a scientific instrument of fundamental importance, and this in turn led him from the contemplation of one type of mechanism to the profound study of the fundamental laws of dynamics.

At heart, Huygens was devoted to the cultivation of science as a purely intellectual pursuit. Geometry, which for him meant Euclidean geometry of course, was the key. But no man of science ever preserved a more harmonious balance between all those sources by which scientific truth can be revealed.

As an acknowledged masterpiece of the first order, the "Horologium Oscillatorium" needs no description. Published in 1673, it is cast in the classical mould in the true line of descent from the Greek geometers. Although the main results embodied in the work were already in the possession of Huygens before he left Holland, as previous volumes of the present edition of his works have shown in detail, they had in many cases not been published in any definite form, if at all. Hence the publication in the shape of a regular treatise constituted an event of capital importance in the history of science in general and rational mechanics in particular. Nothing else is needed to show the remarkable state of development which dynamical ideas had reached at the very moment from which we are accustomed to trace the Newtonian system of dynamics.

Huygens returned finally to Holland in 1681. The present volume, in addition to the capital treatise here presented in French and Latin versions, contains all the fragments of his work bearing on the perfection and performance of the clock between 1666 and 1695. Their interest is mainly of a controversial, or purely technical, kind rather than of a general character.

H. C. P.

British Marine Zoology

The British Sea Anemones. By Prof. T. A. Stephenson. Vol. 2. (Ray Society Vol. 121 for the Year 1934.) Pp. xii+426+16+plates 15–33. (London: Dulau and Co., Ltd., 1935.) 37*s.* 6*d.*

THE sea anemone fauna of Great Britain is now known much better than that of any other area in the world, largely as a result of the twenty years work that has been put into Prof. T. A. Stephenson's magnificent monograph, just completed by the appearance of the descriptive volume.

In addition to the very full accounts of anatomy and the references to all previous work, the author of this comprehensive monograph, although he was obliged to omit his contemplated review of actinian physiology and behaviour, has given many interesting descriptions of the animals' habits. This has been facilitated by the comparative ease with which anemones can be maintained for observation in aquaria, a fact that is proved by the pathetic story of Mr. Evans's *Actinia equina* during the War. Left in an aquarium without food or aeration, in water that was becoming increasingly more salt through slow evaporation, the anemones held on until their owner's return, very much reduced in size, but still recognisable. The palm for longevity under artificial conditions—seventy-three years—is held by the famous individuals of *Cereus pedunculatus* at present in the care of Prof. J. H. Ashworth at Edinburgh.

A few of the discussions of special interest that deserve notice are: parasitism and burrowing habits in *Peachia*; the range of variation and the viviparous reproduction of the well-known and widely distributed *Actinia equina*; the colouring, reproduction and commensal algæ in *Anemonia sulcata*; autotomy of tentacles in *Bolocera*; apparent suppression of tentacular feeding in *Aureliania*; the unusual action of the *Fangtentakeln*, and laceration in *Diadumene cincta*; the puzzle of the distribution, relation to environment, and original home of *D. luciæ*; dwarf races, laceration and planktonic feeding in *Metridium senile*; resorption of tentacles in *Calliactis*; commensalism in *Calliactis* and *Adamsia*; laceration in *Sagartia elegans* and *Actinothoe*; and what may be regarded as neoteny in *Metridium senile* and *Sagartia troglodytes*.

Lovers of the living things of the sea in particular will be grateful to Prof. Stephenson for the help he gives them in the identification of the British anemones. He provides not simply a key, the ends of which might be defeated by careless use, but a combination of a key and a summary of the most important features. The volume is illustrated by numerous and beautifully executed text figures of anatomy and patterning, as well as by eight more exquisitely drawn plates in colour and eleven plates of photographs. Together with the charming and fanciful (if not strictly relevant) vignettes which terminate some of the chapters, they make the work one of artistic as well as scientific importance. It is a critical and masterly account with a good bibliography of a difficult subject by one of the world's greatest experts who, although he has shown himself sympathetic with the demands of the modern schools of physiology and ecology, is not one of those who take lightly the responsibilities of the systematist.

A. K. TOTTON

Short Notices

Methods of Air Analysis. By Prof. J. S. Haldane and J. Ivon Graham. (Griffin's Scientific Text-Books.) Fourth edition, revised throughout and enlarged. Pp. vii+176. (London: Charles Griffin and Co., Ltd., 1935.) 7s. 6d. net.

ALTHOUGH it is twenty-three years since Dr. Haldane's little book was first published, the methods and apparatus which he has described with such minute attention to detail are still in everyday use for the examination of air and mine gases. With the collaboration of Mr. J. Ivon Graham, the fourth edition has now been enlarged and admirably brought up to date without changing the general character of the book.

Owing to the toxicity of carbon monoxide, much attention has been directed of late years to the determination of very small quantities of this gas, for which purpose the portable and laboratory types of apparatus used in the Mining Research Laboratory, Birmingham, and capable of detecting 0·0005 per cent are recommended.

From the point of view of safety in mines, the new chapter dealing with the application of gas analysis to the detection of spontaneous combustion is of particular interest; the authors state that the analytical method is capable of greater sensitivity than the older one depending on smell.

Another trend in the technique of gas analysis has been the development of specialised instruments such as the Hartridge reversion spectroscope and the Katz recorder for carbon monoxide, the McLuckie apparatus for inflammable gases, and the Owens dust collector, to mention only a few of those described in the present volume.

F. R. E.

Handbook of Chemistry: a Reference Volume for all requiring Ready Access to Chemical and Physical Data used in Laboratory Work and Manufacturing. Compiled and edited by Prof. Norbert Adolph Lange, assisted by Gordon M. Forker. With an Appendix of Mathematical Tables and Formulas, by Prof. Richard Stevens Burington. Pp. xiv+1265–248+29. (Sandusky, Ohio: Handbook Publishers, Inc., 1934.) 6 dollars.

THE present reviewer has kept this handbook beside him for several months and has put it to the test repeatedly. It has met the requirements on every occasion, in chemical matters as well as in purely mathematical.

One of the best sections of the book comprises the 234 pages dealing with 4,452 organic compounds, for each of which is given a 'Beilstein' reference, in addition to the usual information. This reference is a particularly useful feature as it enables the reader to find at once the page in the enormous and unwieldy Beilstein where he can obtain further information. The section on inorganic compounds extending to 112 pages is also very useful.

In addition to the data given in the tables just mentioned, all the more important properties are given tables to themselves, and when only a limited list of substances is mentioned, the reader is directed where he can find a more complete list.

Among the interesting and novel features are changes in atomic weights from 1894 until 1933; a large table of alloys (including heat- and corrosion-resisting alloys), classification of crystals; organic reagents for inorganic analysis; laboratory solutions; hazardous chemicals and their handling. There is a wealth of data covering not only a very wide field of pure chemistry (physical, inorganic and organic) but also every conceivable section of applied chemistry. The information is also brought well up to date.

It is impossible to give a complete catalogue of all the subjects treated in this valuable handbook, but great care seems to have been taken to make the information as complete and accurate as possible. Further, considerable attention has been paid to the arrangement of the details, which will be found very convenient.

The Complete Book of British Butterflies. By F. W. Frohawk. Pp. 384+32 plates. (London and Melbourne: Ward, Lock and Co., Ltd., 1934.) 10s. 6d. net.

IT is now nearly thirty years since South's "Butterflies of the British Isles" was first published, and this, in its successive editions, has remained the best book on the subject both for the beginner and the more advanced collector. In 1929, Mr. Frohawk brought out his "Natural History of the British Butterflies", but the price of this was beyond most pockets. Mr. Frohawk has now challenged the supremacy of South's book by re-issuing, in a cheaper form, the essential illustrations from his larger book with good descriptions of all stages of the insects and excellent biological notes. All the illustrations and the greater part of the letterpress are the original work of the author. This has many advantages but some drawbacks, as, for example, a rather sweepingly exact statement that in *Erebia epiphron* "The larval stage lasts 288 days".

References are made to variation, protective coloration and migration, sufficient at least to excite the interest, and, as one would expect from Mr Frohawk, there is an excellent account of the relation of the larva of *L arion* to ants Only one misstatement has been noticed, and that not about a truly British insect, contrary to what is said on pp 38 and 41, the Monarch butterfly has an adult life up to about ten months and has a definite period of semi-hibernation in the southern United States

The classification and Latin names are the most up-to-date possible, that of the Royal Entomological Society's recent list, but the author shows either misapprehension or unbounded optimism where he refers to this as an "established International Rule" and a "permanent International Classification", we wish that it were so ! Among the English names we wonder if he is trying to introduce the law of priority when he replaces the well-known 'Gatekeeper' by the older 'Hedge Brown'

On the whole an excellent book, particularly for the young naturalist in whom the desire for collecting can be replaced by wider biological interests

C B W.

Structural Geology with Special Reference to Economic Deposits By Bohuslav Stočes and Charles Henry White. Pp xv + 460. (London. Macmillan and Co, Ltd, 1935.) 25*s* net

The mining geologist who has a sound knowledge of the various types of crustal deformations and of the form, extent and position of mineral deposits of economic importance with their relationships to the host rocks, is well-equipped for one of the most important aspects of his work, and whilst experience in the field will always remain the best training ground, it is essential that he should be familiar with structural types of various kinds, particularly those encountered in certain mining areas in different parts of the world.

Hitherto, the mining geologist has been handicapped by the lack of a suitable treatise, for although it is true that a number of books on structural geology have been published, few of these appeal strongly to mining engineers and mining geologists, who prefer clear illustrations of dislocations and deformations as revealed by undergound mining, to long and involved descriptions of structural types which are largely hypothetical and based only on surface indications. Dr. Stočes, professor of geology at the National School of Mines of Czechoslovakia, whose former work on this subject was published in both Czech and German, and Dr. White, who has had practical experience as a consulting mining geologist in many countries since his retirement from the professorship of mining and metallurgy at Harvard University, have rendered conspicuous service to mining engineers and mining geologists by the publication of this authoritative volume. It differs from other books on structural geology in at least three important aspects it is written specially for graduate and post-graduate students of applied geology, the reading matter has been wisely subordinated to remarkably clear and well-selected sketches, diagrams and photographs, numbering in all 663, almost two to every page, and the illustrations include a large number of the structural types encountered in mining areas in different parts of the world

W R JONES

Inorganic and Theoretical Chemistry By Dr F Sherwood Taylor Third edition. Pp xiv + 832 + 19 plates (London. William Heinemann, Ltd, 1935) 12*s*. 6*d*. net

The third edition of this book is only 14 pages longer than the first edition, but includes sections on most of the recent developments, such as *ortho-* and *para-*hydrogen, heavy hydrogen, neutrons and positrons, atomic transmutation and artificial radio-elements The current view, that the nucleus is composed of protons and neutrons, is mentioned, but it is not adopted in the figure illustrating the isotopes of neon

Certain weaknesses, which have persisted from the first edition, still call for comment Thus, although a clear distinction is drawn between covalent and electrovalent links, salts are still occasionally formulated as covalent molecules, as when a fictitious ring-structure is assigned to barium peroxide (p 600). Conversely, an ionic structure is incorrectly assigned to hydrogen bromide (p 208), which is surely only ionised in presence of a 'base' or proton-acceptor. The student is also frequently misled by equations in which protons are shown instead of oxonium ions, as in the dissociation of water (p. 137), of acids (p. 186) and of hydrogen sulphide (p. 620) There is also a curious contradiction between the definition of a base (p 186) and a subsequent statement that substances such as ammonia are "incorrectly called bases" (p 194). These features, however, are only of minor importance in a book the merits of which have already been described in an earlier review (NATURE, 129, 919, June 25, 1932)

Technical Gas Analysis. By Dr George Lunge. Revised and rewritten by Dr H. R Ambler Pp. xvi + 416. (London and Edinburgh: Gurney and Jackson, 1934) 21*s* net.

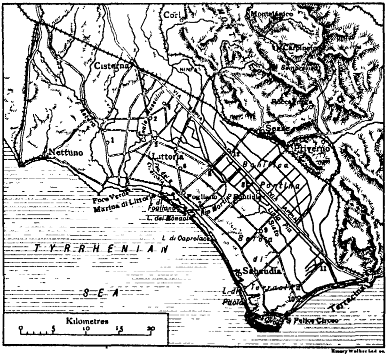
Lunge's book has held the field during twenty years, so that the new edition is overdue. The book has been largely rewritten, it aims at being comprehensive of all processes and types of method, as well as giving detailed working descriptions of the more noteworthy

Gas analysis increases in importance as more industrial operations are brought under scientific control, the degree of accuracy required varying according to circumstances: time is often an important factor. Continuous recording instruments are coming into use when possible The book follows well-known lines, and is illustrated by diagrammatic drawings of the apparatus. It should find a place in all technical and analytical laboratories.

Reclamation of the Pontine Marshes*

By DR ROBERTO ALMAGIÀ, University of Rome

THE Pontine region (in Latin, *Ager Pometinus*, from the name of the ancient Volscian city of Sessa Pometia), known more commonly in the past as the Pontine Marshes, is situated in the southern part of Latium, and has been famous from remote times During recent years, the attention of the civilised world has been directed to it, owing to the extensive reclamation works which have completely transformed its traditional aspect



Emery Walker Ltd sc.

FIG 1 Map showing the Pontine region in 1933.

1 Borgo Bainsizza
2 Borgo Podgora
3 Borgo Piave
4 Borgo Carso
5 Borgo S Michele
6 Borgo Isonzo
7 Borgo Grappa
8 Borgo Pasubio
9 Borgo Vodice
10 Borgo Montenero
11 Borgo Hermada
12 Borgo Faiti

The region lies to the south of the volcanic Latium Hills and occupies the space between the Lepine Mountains—a range composed essentially, like the Central Apennines, of secondary limestones and hence of Carsic structure, and about 1,500 metres high (Monte Semprevisa, 1,536 metres)—and the Tyrrhenian Sea Close to the sea is the isolated Monte Circeo, with a structure analogous to that of the Lepines Towards the end of the tertiary and the beginning of the quaternary periods, the whole territory, with an area of about 750 sq. kilometres, must have been still, as regards its greater part, a shallow marine gulf, Monte Circeo being then an island Later in the quaternary period it became transformed into a lagoon, as a result of upheavals, which were more pronounced near the sea than at the foot of the Lepines Hence the greatest depth of the lagoon was in the interior and followed a line roughly parallel to the mountains Alternating subsidences and upheavals doubtless took place afterwards, the natural appearance of the region being repeatedly changed during prehistoric ages and perhaps also during historic times Climatic variations, affecting the flow of the water-courses and the humidity of the whole region, also came into play To-day the rainfall is less than 800 mm in the coastal district, increasing to about 1 metre at the base of the Lepines and to still more on their slopes

Without going in detail into the characteristics of the Pontine region, it may be pointed out that this may be divided into three parts ·

(1) *The coastal region*, which extends from Nettuno to Terracina This is characterised by long chains of dunes of recent origin, 20 metres or more in height and more or less fixed by vegetation The dunes separate the sea from long, narrow coastal lakes, the Lake of Fogliano, the most northern, having an area of 4 65 sq km and that of Paola, the most southern, an area of 3 9 sq km ; in between come the smaller lakes of Caprolace and Monaci These lakes probably represent ancient creeks, which have become separated from the sea by the formation of the dunes The two larger, exhibiting indentations on their internal shores, communicated with the sea through breaks in the line of dunes, but such breaks sometimes became filled in and so acted only intermittently Moreover, being subject to seasonal changes of level, the lakes were surrounded by stretches of marsh As will be indicated presently, work is in progress which will stabilise their configuration.

(2) *The region adjacent to the lakes* inland stands somewhat higher—20-25 metres and sometimes

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* Translated from the Italian.

40 metres—and consists of sand, often of a chalky nature According to some geologists, this region represents a series of cemented quaternary dunes, which were hitherto the undisputed domain of the Mediterranean scrub and of tall forests, with only limited clear areas

(3) *The true internal region*, lying between the preceding and the foot of the Lepines, constitutes the marsh proper and corresponds approximately with the deepest part of the ancient lagoon The hydrographical conditions of this region were very irregular and variable Abundant Carsic springs at the base of the Lepines—such as those of Ninfa—fed comparatively large water-courses, the natural flow of which was hindered by the slight slope of the ground, by the chain of dunes, by the vegetation, etc

The soil varies in character throughout the region, being rich in humus and fertile in the lowest parts, where it is mixed with detritus of volcanic origin, mostly clayey and marly in the higher areas, and sandy and hence little suited to farming near the sea The region is said to have been well cultivated and thickly populated in the Volscian age (twenty-four inhabited centres are spoken of, the largest being Pometia) The destruction of the Volscian State and its subjection to Rome, together with the abandonment of the drainage schemes, in which the Volscians must have been highly expert, and possibly also climatic changes, resulted in desolation. Actually, however, there is little exact knowledge of the conditions of the region in the pre-Roman epoch, but in early Roman times the marshy areas must have been very extensive Attempts at reclamation date back to the end of the Roman Republic. Others were made during the Empire, in the Middle Ages by enterprising pontiffs like Martin the Fifth, and in modern times, under Leo the Tenth, Sixtus the Fifth and Urban the Eighth, who made appeal to the experience of Dutch engineers The most impressive endeavour was that made at the end of the eighteenth century on the initiative of Pius the Sixth, but the main drainage canal, constructed over a length of about 30 km parallel to the Appian Way, and fed by lateral channels, proved inadequate to drain the whole of the marshy area. This area, including land boggy only at times, amounted to 370 sq km. Napoleon caused the problem to be studied again by well-known hydraulic engineers, such as Fossombroni, but failed to find time to give effect to the projects elaborated

It is not possible to give here the history of the successive efforts made in the nineteenth century or of the earlier ones of the present century, which, like the splendid work of Pius the Sixth, led only to a partial and temporary solution. The more the problem was studied, the more complex it appeared The drainage question was, indeed, the first, but not the only one, demanding solution, as it led naturally to the sanitary problem—the struggle against malaria and the creation of the conditions for healthy existence There was also the agrarian problem, comprising preparation of the soil for its immediate utilisation, population and colonisation, and installation of roads and other means of communication All these issues required simultaneous resolution, and this was the aim of the law of Integral Reclamation (*Bonifica integrale*), which concerned Italy as a whole, but found in this region its greatest and most complete application The whole of the work involved was entrusted to the Opera Nazionale dei Combattenti

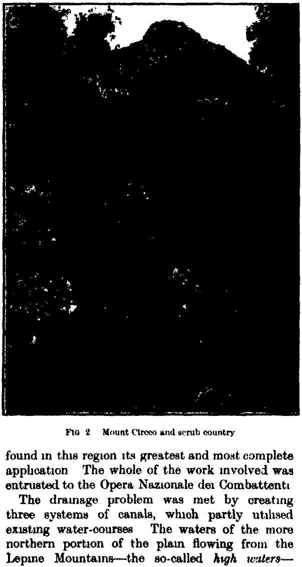

FIG 2 Mount Circeo and scrub country

The drainage problem was met by creating three systems of canals, which partly utilised existing water-courses The waters of the more northern portion of the plain flowing from the Lepine Mountains—the so-called *high waters*—were conveyed to the sea by a direct route, mainly by an extensive collecting canal (the Mussolini Canal), which is 27 km long and is the most important drainage work yet accomplished This is able to deal with a flow of 450 cubic metres per second and flows, under suitable control, into the River Astura *The middle waters* flow into another large collector and pass to the sea through old water-courses, the principal of these being the Martino River (the work of Pope Martin the Fifth) and its tributaries the Cicerchian and Nocchian 'ditches', which have been re-organised *The low waters* flow partly into the Pia water-course, which is still in good order, and partly are collected by a network of channels and led to the Fiume Sisto (named after Pope Sixtus the Fifth), the bed of which has been widened and deepened In all, 1,756 km of canal have been excavated and renovated Other work has resulted in the drainage of many wells and stagnant pools throughout the scrub zone—the so-called *Piscine* Operations on a still larger scale are in progress with the object of keeping the coastal lakes within definite bounds A number of difficult technical problems are here involved Work on Lake Fogliano, which is well stocked with fish, is already well advanced ; its bed is being deepened, its banks made up and the marshy margins dried, and permanent connexion with the sea is being established. Development of Lake Paola and of the district of Sabaudia on its shore is likewise proceeding. Work on the two smaller intermediate lakes is also under way ; in the case of Lake Caprolace, certain areas around it are below sea-level, and have needed special means for drainage.

The reclaimed lands were not as a rule ready for immediate cultivation. In most cases deep tilling and manuring, particularly with phosphates, have been necessary Great difficulty has been encountered in the destruction of the thick Mediterranean scrub, consisting of deep-rooted trees, and both fire and dynamite have been employed to get rid of the roots For tilling, use has been made of powerful multiple ploughs of the Fowler type The so-called Terracina Forest, containing most of the tall trees, has been preserved for inclusion in a national park, which takes in also part of Monte Circeo.

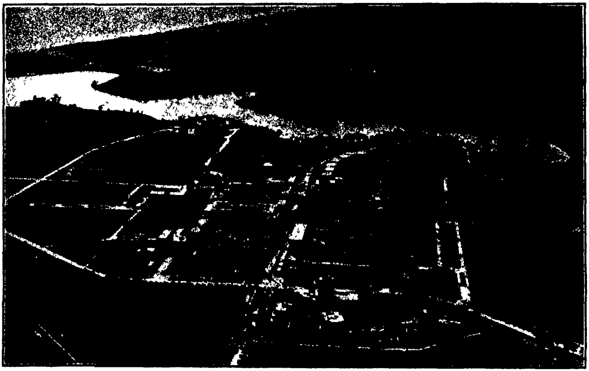

FIG 3 The new city of Sabaudia

The whole plan of reclamation outlined above was, as already mentioned, put into the hands of the Opera Nazionale dei Combattenti at the end of 1931. The average daily number of workmen employed was 13,500, board and lodging being provided for them by the creation of two large villages, as well as a number of smaller settlements

During the first year—to October 1932—10,500 hectares were reclaimed and made ready for cultivation, in the second 14,100 and in the third about 17,000 The total agricultural land thus made available by the end of 1934 exceeded 41,500 hectares. In addition to the actual ploughing, etc., this necessitated the construction of houses and other buildings for the new colonies, and the creation of a network of roads, etc so as to render the region fitted for permanent occupation.

All this has involved revolutionary changes.

since, until a few years ago, the Pontine region had no stable population The section of coast from Nettuno to Terracina was, perhaps, one of the longest tracts of desert coast in the whole peninsula A few hamlets (*casali*) existed along the Appian Way, and two or three in the remaining territory. From remote times the region had had a transitory population engaged in wood-cutting, production of charcoal, and raising cattle, sheep and pigs This population lived in the most primitive huts, which contained only a single apartment and had a small, low door, with no other opening The contents consisted of a hearth built of a few stones, beds, and a few essential articles of furniture. Such huts were found especially in the forest clearings (*lestre*), sometimes in groups of three or five or more, and occasionally in villages with a hundred or more inhabitants This population came from the villages of sub-Apennine Latium (Filettino, Trevi, Veroli, Alatri, etc) and spent eight or nine months in the region (October–June).

The huts have now almost entirely disappeared, and separate farmhouses, of two or three different types, are being built at regular intervals in the newly reclaimed area As is natural in an agricultural district, the populace is a scattered one On an average, 10–12 hectares of land, with house, are allotted to each family, the area being increased twofold on the poorer soils Each farmhouse comprises living rooms, with stables below for the larger cattle Small accessory buildings contain a furnace and accommodation for pigs and chickens, and a well and drinking troughs for the cattle are also supplied, together with implements, chemical fertilisers, etc. After a certain period of tenancy, the farms will pass into the possession of their occupiers. During the first three years, ending with the year 1934, about 2,450 farmsteads were built, the colonisation proceeding from north to south and from the coastal districts inland

At certain points, chosen for ease of access, centres known as boroughs (bearing the names of battle-sites) have been instituted. Of these boroughs (*borghi*), which include a bureau of agricultural control, a health station, sometimes a school, a church, etc., twelve had been formed by the end of the year 1934. In view, however, of the vast extent of the area colonised, more important urban centres were also required to provide public services, business establishments, hotels, hospitals, places of entertainment, etc. The first of these, **Littoria**, was commenced on June 30, 1932, on the site of the former Quadrato, and was inaugurated on December 18 of the same year. The second, **Sabaudia**, situated in a magnificent position on the inner shore of Lake Paola, was begun on August 5, 1933, and officially opened on April 15, 1934 In October 1934, the first stone was laid of the third urban centre, Pontinia, in the farthest inland and lowest region, near the Appian Way, and in a zone where the work of reclamation has only just been begun ; this was to be ready for occupation in April, 1935 Two further urban centres, Ausonia and Aprilia, are already projected

Population of the agricultural districts of the Pontine region has been accompanied by that of the coasts, where seaside resorts have been developed. Among those already built are Foce Verde—to serve the Cisterna country—and Littoria Under construction is Sabaudia Beach, which will be connected with the main centre by a bridge over Lake Paola at its narrowest point During the past summer a seaside colony entertained 400 children from the families of the farmers of the Pontine region

As regards the population of this region, it should be pointed out that the occupants of the new settlements are derived, not from the district that formerly supplied its temporary inhabitants, but from distant, over-populated parts of Italy · Friuli, Vicentino, Polesine, Ferrarese, etc Admission to the colonies has been rigorously controlled, preference being given to the families of ex-service men and, among these, to the more numerous

Whereas, in the past, the Pontine region had only a single road for wheeled traffic—the old Appian Way—and a few tracks and bye-ways, the whole of the colonised portion is now traversed by a fine network of roads (416 km up to the end of 1934), adequate to meet the requirements of the new conditions and arranged according to a predetermined plan

The mainstay of agriculture is corn, which has cropped well during the first three seasons in the Littoria district Tree-fruit is also being grown and, in the south, horticultural produce—notably tomatoes, in the district between Terracina and Circeo The lower slopes of Circeo and the environs of Terracina have been noted from ancient times for their vines Beet-growing has commenced and the installation of a sugar factory at Littoria is projected. Attention will, however, probably be devoted mainly to corn, of which Italy is greatly in need.

The profound transformation brought about in Southern Latium by the Pontine reclamation is felt also in adjacent districts, especially in the Lepine towns, the relations of which with the plain below date from the earliest times The new condition of things has also had an important consequence from the administrative point of view, as it has determined the creation of a new province—the ninety-third in Italy—which embraces a vast region reaching, towards the south, to the River Gargliano and having Littoria as its capital

The new province of Littoria has an area of 2,100 3 sq km and a population now approaching 200,000 The capital, Littoria, is a city constituted almost exclusively of offices, business houses, places of assembly, scholastic establishments, hospitals and the like, etc Its fixed population is only 2,500, but, like Sabaudia, it has been planned with a view to extensive development in the future

To Sir Charles Vernon Boys on his Eightieth Birthday

Why does Sir C V Boys elect
To do the things we least expect,
And always choose a task that seems
More suited to the land of dreams
A problem other men would shirk,
Yet solve the task, and make it work
By means that *no one* else employs ?
The answer is Boys will be Boys !

What made him buy an Otto bike—
Two wheels abreast—a thing to strike
Terror in any rider's soul,
Yet somehow manage to control
Its actions and avoid a spill,
And using his uncanny skill -
Delight in a precarious poise ?
Again we say Boys will be Boys

Why snatch a bullet in its flight,
Lit by a single spark so bright
That on a photographic plate
The fleeting shadow seemed to wait—
With wake and bow-wave primly set -
All posing for their silhouette—
And leave a picture of the *noise ?*
Because, of course, Boys will be Boys !

Why did his bold, untrammelled thoughts
Conceive the scheme of fusing quartz,
Using an arrow, as it fled,
To draw a microscopic thread,
And from the fusion to "unreel"
A gossamer more true than steel,
Which every Physicist enjoys ?
The fact is this Boys will be Boys

What made our friend so seeming rash
As to pursue a lightning flash
By lenses rapidly revolved,
And even get the problem solved -
Both of its speed and structure—by
A photograph "which cannot lie" ?
That gave a thrill that never cloys,
And showed us still, Boys will be Boys

To weigh the earth—to check the Therm --
Explain the logarithmic term—
To build with bubbles, and maintain
The opal colours in their train !
These are his pleasures, these his ploys
(Where skill with mind and Truth allows)
For which, in Science, as in Toys,
We thank our stars, Boys *will* be Boys !

R A S P

Obituary

SIR GEORGE CORY

SIR GEORGE CORY, who died on May 7 at seventy-two years of age, had spent forty-four years of his life in South Africa He received his scientific training at King's College, Cambridge, where he took honours in the Natural Sciences Tripos in 1888 After holding various academic appointments in the schools of Grahamstown, which is in the Eastern Province of Cape Colony, he was appointed professor of chemistry in Rhodes University College in 1904, and occupied the chair with great distinction until his retirement with the title of professor emeritus in 1925

Cory was undoubtedly a good teacher and was beloved both by his colleagues and his students, whom he could, and did, inspire with his own enthusiasm Indeed, some of his men have done extraordinarily well, but the truth is that though his heart was in his work, his real interest in life lay elsewhere As a consequence of this, no scientific discoveries of any great value can be placed to his credit He had neither the temperament nor the vision for chemical or physical research, and as Rhodes College was off the beaten track, there were no chemical souls with whom he could commune

Cory was really an antiquary Very soon after his arrival at Grahamstown, where much of the early South African history was enacted, he realised, as indeed did others, that records of the doings of the 1820 settlers and of others would soon be lost if an attempt was not made to collect them While others talked, Cory acted He never took a holiday, but spent all his spare time in trudging over the country covering great distances, enduring much physical discomfort, to carry on his self-imposed task All interested in South Africa know that his "Rise of South Africa", in six volumes, was practically completed some little time ago For his work in this and in other but similar directions, Cambridge awarded him the honorary degree of D.Litt. in 1921 and when he was knighted in 1922 he came to England which he had not seen for more than thirty years and did further historical research. He was awarded the gold medal of the Royal Empire Society in 1933.

MR. W R BUTTERFIELD

THE town of Hastings has suffered a grievous loss through the death of its museum curator and librarian William Ruskin Butterfield came from Bradford in 1894 as a school teacher, and soon began to take a prominent part in the work of local scientific societies as a field naturalist In 1905 he was appointed curator of the museum in the Brassey Institute, Hastings, and in 1909 librarian of its reference library, both of which under his care grew greatly in importance as centres for the study of the natural history, archæology and arts of south east Sussex In 1929 the mansion of John's Place was purchased by the town as a home for the museum This gave Butterfield his opportunity. In its new quarters under his skilful hands the museum became a live thing, each room the sanctuary of a particular science or art Meanwhile, the reference library was rehoused in the old museum, and a lending library and reading rooms were added The whole was a wonderful achievement for a man constitutionally unable to delegate responsibility, but a breakdown in health followed. From this, Butterfield recovered sufficiently to set up as an annexe to the museum the "Indian Durbar Hall" (from the Colonial and Indian Exhibition of 1886) which had been given to the town by the late Lord Brassey, and to arrange in it with his old skill the collections of "The Voyage of the Sunbeam", but he never regained complete health and died suddenly on March 24 at the age of sixty-two years

Butterfield was a great Nature lover and an accurate observer, and he contributed papers to the *Museums Journal*, of which he was for a time editor, and to local scientific periodicals His knowledge of the locality embraced not only his favourite subjects of birds and insects, but also every branch of natural history and archæology This first-hand knowledge made him an excellent expositor, whether in the museum or on Nature rambles, and many hundreds of townsfolk must owe their first interest in science to his inspiration T S D

WE regret to announce the following deaths

Sir Robert Blair, education officer of the London County Council in 1904-24, on June 10, aged seventy-six years

Mr J T Cunningham, lecturer in zoology in Queen Mary (East London) College in 1917 26, on June 5, aged seventy-six years

Mr Daniel Nicol Dunlop, O B E, a director of the British Electrical and Allied Manufacturers' Association, and a founder of the World Power Conference, on May 30, aged sixty seven years

Prof R M Holman, associate professor of botany in the University of California, an authority on the longevity and germination of pollen, and author of well known botanical textbooks, on April 23, aged forty-nine years

Prof Alice Werner, C B E, emeritus professor of Swahili and the Bantu languages in the University of London, on June 9, aged seventy-five years

News and Views

The Actonian Prize of the Royal Institution

THE Managers of the Royal Institution have awarded the Actonian Prize for 1935, of one hundred guineas, to Mr W T Astbury, for his papers on "X-ray Studies of the Structure of Hair, Wool and Related Fibres" The Prize is awarded septennially, and is given, in the quaint phrasing of the deed of trust of the Acton Endowment, to the "author of the best essay illustrative of the wisdom and beneficence of the Almighty in such department of science as the said Committee of Managers for the time being of the said Institution shall in their discretion select" It is provided that the award may be made in respect of essays or papers already published Mr Astbury was for some years an assistant in the Davy Faraday Research Laboratory of the Royal Institution, working with Sir William Bragg on various problems in connexion with the X-ray analysis of crystal structure He left the Laboratory in 1928, and is now lecturer in textile physics and director of the Textile Physics Research Laboratory of the University of Leeds. He has applied the X-ray technique acquired during his earlier work to textile problems, and the Actonian Prize is awarded to him in respect of the two valuable papers, under the general title given above, published in the *Philosophical Transactions of the Royal Society.*

Dewar Research Fellowship

THE bequest by Lady Dewar of a sum of money for the furtherance of research in the Royal Institution, in memory of the work of her husband, the late Sir James Dewar has already been announced The Managers of the Royal Institution have resolved, as the best method of giving effect to Lady Dewar's wishes, to establish a Dewar Research Fellowship, and conditions governing the award of the Fellowship have now been drawn up The research must be carried on at the Royal Institution, in a branch of science at the discretion of the Managers The appointment, which is open to persons of either sex, will be for a period of three years in the first instance, with a possible extension to five, and will carry with it a salary of £400 a year It is hoped to appoint the first Dewar fellow later this year, and applications are being invited through the usual channels

Award to Sir Frederick Banting

THE Society of Apothecaries of London at a Court Dinner held in Apothecaries' Hall at Blackfriars on June 4 conferred upon the discoverer of insulin, Sir Frederick Banting, the Society's Gold Medal in Therapeutics, the highest honour which the Apothecaries' Company can bestow After the presentation, Sir Frederick thanked the Society on behalf of those who were associated with the early work on insulin, and referred to the desire of Canadians to be in touch with 'the old land'. He said that, as professor of medical research in the University of Toronto, he saw research students passing away from the University; in one year forty-five per cent of the graduates of the University went to the United States; nevertheless their bond with the British Empire was stronger than with America; their desire was to become more British. He asked that Canadian students should be made kindly welcome in Britain in order that their sentiments of kinship might be made stronger. In Canada they are endeavouring to send their students to Britain, for the great thing about British medicine is that it rests on a solid foundation. Traditions are only beginning in Canada; in this respect there is a great difference from Britain. The Canadian who comes over here takes back with him on his return some of the high traditions which guide men in Great Britain. The bonds of fellowship are stronger and more enduring than financial inducements, which are a source of weakness. Sir Frederick's great wish is that the ties with Britain should be strengthened.

The Quetta Earthquake

FEW details of scientific interest have as yet reached England from the Quetta district. Shocks of course continue to be felt, some of them strong enough to bring down walls left standing among the ruins. The destruction of Quetta City is almost complete. Landmarks of all kinds have disappeared, and the city is a widespread mass of debris. An official report gives the number of killed in it as 26,000 out of a population of 40,000. In addition to the towns of Kalat and Mastung, at least one hundred villages have been totally destroyed within a band 130 miles long and 20 miles wide, the number of killed in them being estimated as between 12,000 and 15,000, so that the total number of deaths is probably about 40,000. So impossible is it to excavate the dead bodies in Quetta City that all the survivors have been removed in fear of an outbreak of disease. The city has been surrounded by barbed-wire entanglements and will be protected by guards in order to save the property of survivors from marauding tribesmen; it is intended that the city shall remain so sealed for a whole year.

International Co-operation in Americanist Studies

AN important proposal for the promotion of studies in American ethnology and colonial history on an international basis is to be submitted to the next General Assembly of the League of Nations. It originated with M. Levillier, delegate of the Argentine, who proposed to the last General Assembly that arrangements should be made for the publication by international co-operation of a series of original and authoritative works dealing with the indigenous peoples and cultures of the Americas and with the history of the discovery, geographical exploration, conquest, settlement and colonial government of the continent in the sixteenth century. The proposal was approved in principle and referred to the International Institute of Intellectual Co-operation for consideration and report on the organisation and financial arrangements necessary to give it effect. Such a scheme has now been prepared by a committee of Americanists appointed by the International Institute. The Committee is a strong body of distinguished diplomatists and historians; but as much stress is laid on the importance of the ethnology of America and the history of indigenous cultures, it is a little surprising to find that anthropology is represented on the Committee by one member only. Although that member, M. Paul Rivet, is a host in himself, it might, perhaps, have been expected that some, at least, of the numerous distinguished authorities on American ethnology and culture would have been included in the list of those consulted by correspondence, where Prof. Stolyhwo of Warsaw appears as the only anthropologist.

THE suggestions of the Committee provide for the publication of, approximately, fourteen volumes dealing with indigenous ethnology and culture, and fifty dealing with the historical side of Americanist studies. These volumes would be published over a period of years at the rate of, say, four a year, two in ethnology and two in history. In a comprehensive and detailed synopsis of topics, the subject-matter has been classified into six sections, of which the first covers the geology and natural history of America and the archæology, physical anthropology, demography and culture of the Indians. The remaining five sections cover European relations with America before and after the Spanish discovery, the history of the discovery and exploration of the various parts of the continent, the conquest, the colonial period and administrative, social, religious and economic organisation during the sixteenth and down to the beginning of the seventeenth century from all points of view. The preparation of the volumes, which will appear in English or French, and will be in the nature both of monographs on specific points of research and treatises of a synoptic and general character, will be entrusted to scholars of admitted and international repute. The general aim of the Committee in preparing the scheme has been to promote the better mutual understanding of the peoples of the Americas and Europe and at the same time to remove popular misconceptions as to the methods and aims of the conquistadores and early colonists. While the Committee is unable to suggest precisely the price at which volumes should be published, as this must vary according to the amount of illustration, it mentions as an approximate figure 60 francs, with a subscription price of 40 francs, and invites advance promises to subscribe in order to facilitate consideration of its proposals.

Origin of Man Again

AT the Victoria Institute or Philosophical Society of Great Britain, on March 25, Mr. Douglas Dewar read a paper entitled "A Critical Examination of the supposed Fossil Links between Man and the Lower Animals". The paper contains no critical examination of any of the fossils, but it shows how expert opinion has differed regarding the interpretation of the relationships of the relatively few specimens which have been found. The interpretation of fragmentary fossils is a ticklish business (witness the controversy regarding the significance of the Caithness fossil *Palæospondylus*, notwithstanding that scores of complete specimens are known), so that no one need be unduly disturbed by different interpretations of anthropoid fragments. Nevertheless, Mr Dewar correctly sums up the position when he states that "science can truthfully say that it knows not when, where or how, man originated", but he understates the truth when he says that this is all that science knows, for although there is "no conclusive evidence that any Primate genus has been transformed into any other genus", there are resemblances in detail and gradings which require much explanation if transformism is to be rejected To say that "each new type appears in the rocks having all its characteristics, as if it had migrated from some other locality", simply pushes the problem back to the 'other locality' How did it originate there ?

Special Creation or Evolution ?

MR. DEWAR does not say so, but probably he would agree with the view of the president of the Victoria Institute, Sir Ambrose Fleming, that man and every other genus began as a special creation In support of that thesis, Sir Ambrose regards the Java, Heidelberg, Piltdown and Pekin 'men', as biological abnormalities, passing over the probabilities against the disappearance of all the normal forms of their time, and the preservation of abnormalities only He holds that "if nearly as many [human] individuals die as are born in a year, there can be no particular contest for food and one of the factors in the Darwinian causes of evolution is thereby removed" ("Modern Anthropology *versus* Biblical Statements on Human Origin". Second edition. London. Victoria Institute, 1935 1*s*) But this mortality rate is what actually happens in every stable species of plant and animal, and the enormous destruction has generally been regarded as affording just that opportunity for selection which Darwin postulated These and other aspects of the anti-Darwin controversy are dealt with in a lively booklet by Sir Arthur Keith, "Darwinism and its Critics" (The Forum Series, No. 20 Pp. vii+56 London. Watts and Co., 1935 Paper, 7*d*. net, cloth, 1*s* net), in which he defends the theory of evolution against the arguments of Sir Ambrose Fleming, and of other critics, some obviously ill-informed as to the facts. Sir Arthur clings to his hard-hitting style, but his punches are clean, and he swings a good knock-out. Also he adheres to the adage of a recent school grammar book—"explain clearly, as if to a Scotsman . . ."

London Television Station

THE Postmaster-General announces that the Television Advisory Committee has recommended the adoption of the Alexandra Palace for the London Television Station. This recommendation has been approved by the Postmaster-General, and the British Broadcasting Corporation has made arrangements with the Alexandra Palace trustees for the use of a portion of the buildings for the station The ground at the Alexandra Palace is 306 ft above sea-level, and it is proposed to erect a 300 ft mast on the site, thus providing an aerial height of 606 ft above sea-level which, it is considered, should enable a high definition television service to be provided for the London area The Baird Television Company and the Marconi-E M I Television Company are being invited to tender for the supply of the necessary apparatus for the operation of their respective systems at the station The Baird Company proposes the adoption of a standard of picture definition of 240 lines sequential scanning, 25 picture traversals a second, 25 complete frames a second, and the Marconi-E M I Company propose a standard of 405 lines, 25 pictures a second, interlaced to give 50 frames a second, each of 202½ lines The Committee proposes that the vision signals shall be radiated on a wave-length of about 6 6 metres and the associated sound signals on a wave length of about 7 2 metres

Television in Germany

A REGULAR television transmission service has already been inaugurated in Berlin by the German Post Office authorities, and arrangements are made whereby the public can attend demonstrations so that they may see for themselves what the new service has to offer An article describing the proposals for the further development of television in Germany was given in the *Wireless World* of May 24, as an abstract of a paper by W Scholz, recently published in *Elektrische Nachrichten Technik* The television transmissions are of the 180 line, 25 pictures per second type and are given on ultra-short waves of less than 8 metres Both sound and vision transmissions take place on these wave-lengths, so that a single heterodyne oscillator may be used at the receiver for both portions of the programme A total band-width of 2,400 kilocycles per second is allocated to each station for the combined programmes In the scheme proposed, it is assumed that a minimum field-strength of 1 millivolt per metre has to be provided, and that the transmitters will have aerial powers of from 2 to 20 kilowatts on wave-lengths between 5 7 and 7·5 metres The lower-power stations will be erected on mountain peaks at heights ranging up to 4,000 ft, and it is estimated that the effective range of these stations will be of the order of 85 miles On this basis, it is considered that the whole of Germany can be provided with a television service by means of twenty to thirty stations, the wave-lengths being distributed geographically so as to avoid mutual interference.

Progress in the Gas Industry

THE seventy-second annual general meeting of the Institution of Gas Engineers was held in London on June 4–7 under the presidency of Mr. C. Valon Bennett of Rochester. He reviewed the present position and general trends in the industry as a supplier of solid, liquid and gaseous fuels There is a movement for gas works to pass into the control of holding companies, a process which has led at times to increased efficiency and a reduction in prices to the consumer Mr Bennett indicated the dangers to be feared where undertakings were bought at inflated prices, owing to the availability of cheap money, and where the motive force was financial opportunism irrespective of public good In some countries, organisations have been established for the official testing and certification of gas appliances Mr S Lacey and Mr C A Masterman contended that such a movement could bring no advantage in Great Britain, where the safety and efficiency of gas apparatus already exceeds that current in other countries Mr W L Boon described the rapid advance of gas coke in public favour for domestic purposes. The development of the gravity feed boiler has resulted in coke displacing oil firing of central heating installations With these boilers, uniform conditions can be maintained automatically, with attendance once in 24 hours, at a very low fuel cost Open coke grates are increasing in popularity and already some 70,000 have been installed in London alone

Flock of Birds Mistaken for Sea-Serpent

LIEUT A. J. COBHAM, R N , sends us an account of a flock of low-flying birds being mistaken for a sea-serpent Similar observations have been made before, but it is worth while to put Lieut Cobham's notes on record On March 14, 1935, H.M.S *Electra* was 100 miles S W of C Spartel (North Africa) At about 17 30 G.M T , weather being fine and visibility a maximum, Lieut. Cobham was on the bridge with a midshipman and a signalman Suddenly to the westward, about 200 yards off, what seemed to be a sea-serpent was seen, travelling at about 30 knots on a slightly divergent course. "It had a small head, on the surface, creating a bow-wave, and behind, at intervals of approximately 12 feet, there were four humps, each with a bow-wave Every 20 seconds or so the beast submerged for a few moments. Inspection with binoculars showed the phenomenon to be a flock of small birds of the guillemot family (*Alle alle* or *Fratercula arctica*). They were flying in five 'V'-formations, skimming so closely over the water that from time to time they were hidden by a swell. The light, due to a heat haze, was peculiar The sea, to the westward, appeared to be an oily grey colour, against which the birds showed black All three of us had the same impression on sighting, and so 'real' was the appearance that after establishing the truth with binoculars, the birds still looked exactly like a sea-serpent when seen with the naked eye "

Avon Biological Research

THE annual report of the biological research which is being carried out on the River Avon at Southampton in association with the University College there gives an account of the varied lines of work pursued in the second year of this scheme (Southampton . University College 2*s* 6*d*). The general condition of the coarse fish in the area is described, with a special note on the incidence of 'black spot' disease among them Methods are being sought for checking the loss of fish in mill-races, in the flooding of water-meadows, and by poisoning from decaying masses of weed The use of green light has been tried to deter fish from entering dangerous waters, as well as a revolving fish screen which automatically keeps itself free from debris Preliminary experiments have been made on the hatching and rearing of salmon and trout under natural and artificial conditions, and the resulting yield and condition of young fish were determined The work was seriously hampered throughout by the drought conditions of 1933–34

National Institute of Agricultural Botany

THE fifteenth annual report (1933–34) of the National Institute of Agricultural Botany, Cambridge, shows that continued progress has been made in all departments An important change in the stations at which crop testing is carried out took place in the autumn of 1934, when a new centre was established at Askham Bryan near York, in place of that at Good Easter, Essex, which was closed down The results at the latter station had proved so similar to those at Cambridge, that it seemed more valuable to extend the Institute's activities in a northward direction. Two new winter wheats from the Cambridge University Plant Breeding Institute were tested (162/8/1*E*, and W 70 *A*) and gave very promising results, while 'Resistance', the new winter oat which had proved so outstanding in former trials, was put on the market for distribution Continued progress is recorded in the work of the Official Seed Testing Station, 29,487 samples being dealt with during the year under review. With regard to the activities of the Potato Testing Station at Ormskirk, eighty-seven entries were received for the official immunity trials, and all but three of these remained free from wart disease in the field It is noteworthy that, with the exception of three varieties known to be duplicated, all the new varieties entered for the trials proved to be distinct. This is a striking tribute to the way in which the Potato Synonym Committee has been able to check the practice of distributing old varieties under new names and at an enhanced price

Report of the Development Commissioners

THE twenty-fourth report (1933–34) of the Development Commissioners which has just been published (London : H.M. Stationery Office. 2*s*. net) deals mainly with the various purposes for which advances from the fund were made to assist agriculture, rural economy and fisheries. In general, the allocation of grants was very similar to that in the previous year, but although no actual payments were made, arrangements were completed whereby the work at certain British institutes, hitherto financed by the Empire Marketing Board, could be continued.

Since detailed descriptions of the scientific work in progress at the various research institutes aided by the Development Fund are published elsewhere, only a brief outline of their work is given in the present report. The scheme, organised by the Society of Friends, for assisting unemployed men in cultivating allotments, was once again given financial support, in view of the great success of the work in 1933. Disappointment, however, is expressed that it was not possible to assist as many as had been hoped, chiefly owing to the difficulty in securing suitable land. The Rural Economy Section reports progress on nearly all sides, and rural industries are being developed over most of Great Britain on practical and profitable lines. Fishery research has also produced valuable results, particularly with regard to the herring and haddock industries. The determination of the best-sized mesh to use to ensure that undersized fish are not landed has enabled definite legal regulations to be enacted, and the survey of young haddock stock has rendered it possible to forecast the quantities of marketable fish and their probable distribution in future years. The report concludes with a financial statement and a schedule of the grants allocated during the year under review.

Agricultural Research in East Africa

THE Colonial Office has issued the sixth annual report (1933-34) of the East African Research Station at Amani (London: H.M. Stationery Office. 1s. net), from which it is evident that progress has again been made in all the various research activities with which the Station is concerned. As regards coffee investigations, the earlier impression that heavy applications of organic manures to *arabica* coffee effectively offsets the harmful influence of soil acidity has now been confirmed, while culture solution studies suggest a marked correlation between acidity of the medium and the degree of branching of the roots which occurs, high acidity being associated with an unbranched type of root system. Results of importance have also been obtained by the plant pathology section, as the vector of the mosaic disease of *Cassava* has been definitely proved to be a species of white fly (*Aleurodidæ*). On the biochemical side comes the discovery that the fermentation of coffee is an unnecessary process so far as quality is concerned, though the difficulties of correlating quality with the method of preparation of the coffee are still not overcome. The cultivation of sisal (*Agave amaniensis*) continues to increase, and the first lot of seedlings raised at the research station are now becoming available for fibre tests, the standardisation of which has been considerably developed during the past year.

Fishery Research in the U.S.S.R.

THE organisation of fishery research in the U.S.S.R. is the subject of a brief but highly important article by Prof. B. S. Ilyin in the current issue of the *Journal du Conseil* (9, No. 3. Conseil Permanent International pour l'Exploration de la Mer. Andr. Fred Høst et Fils, Copenhague. December 1934). The Scientific Institute of Marine Fisheries, formerly the Central Scientific Institute of Fisheries (Moscow), and the State Institute of Oceanography (Moscow) have been united under the name of the "Union Scientific Institute of Marine Fisheries and Oceanography". The new Institute is designed to function as a planning, guiding and co-ordinating centre for the activities of the numerous fishery stations situated around the coasts of the U.S.S.R. Its purpose is to promote the welfare of the fisheries by acquiring data concerning marine biological and oceanographical phenomena, and intelligently applying the results. In this connexion the formation of an economic section is of especial interest and importance in view of present events and tendencies in the fishing industry of Great Britain. The Institute will issue three series of publications—*Transactions*, *Records* and *Bulletins*—all in Russian, but the first two will be furnished with English, French or German summaries. The address of the Institute is Moscow, Verkhne Krasnoselskaya 17.

Research in the Electrical Industry

THE fourteenth annual report of the British Electrical and Allied Industries Research Association (the E.R.A.) shows that the electrical industry is fully alive to the commercial value of research. It has been well supported both by the Government and the various branches of the industry during last year, and although we do not agree that there can never be a point "at which research has all the support it needs and deserves", it has certainly not been "oversubscribed" in the past. The long list of researches the Association has before it, still inadequately financed, shows that there is need for further co-operative help. It is interesting to read that designers of insulating material for electrical material are now attaching less importance to a knowledge of the electric strength of their materials and more to their thermal conductivity. The importance of Fourier's theorems on the conduction of heat is being fully recognised, and also that temperature is a leading factor in electrical breakdowns. For some years the flame of the Méker burner has been the standard for the determination of "resistance to naked flame". It has been found that the standardisation of the burner flame in conjunction with simple correction factors is unsatisfactory, as flame temperature is not correlated to the calorific value of the gas in a simple manner. Further experiments are being made to develop a standard flame for scientific tests in connexion with 'inflammability'. The electrical resistivity map of the soil of England and southern Scotland has now been completed, and a summary of the work done on telephone interference has been published. Tests on radio interference are in progress. A list is given of the Government departments, engineering and scientific institutions, universities and colleges which have co-operated in the work of the Association.

Progress in Radio Communication

A paper by Col. A. S. Angwin giving a review of the progress of radio communication for the year

1934 (*J. Inst. Elec. Eng.*, Feb. 1935) is of general interest. The great technical progress made in broadcasting during the last two years is reflected in its rapid development. At the beginning of 1932, the number of licensed listeners in Europe was nearly 14 millions, and two years later it was nearly 20 millions. In 1929 the total power used in broadcasting was 420 kilowatts, whilst five years later it was more than ten times greater. Now that an average high-power station consumes 2 million electric units a year, it is important to use only transmitters of high efficiency. The extended use of short-wave telegraph working in ships has enabled the British P.O. stations to communicate regularly with whaling boats in the antarctic and in eastern waters. Directive aerials have been erected at these stations covering all the main shipping routes of the world, and this has greatly improved the services. Additional radio-telephone services from Great Britain to South Africa, Egypt and India have been opened up, while services to Japan, Shanghai, Kenya and Iceland are projected. By extension to circuits already existing, radio communication is now possible with nearly all the South American States. The outstanding feature in radio research has been the intensive study with the help of the cathode ray oscillograph of the propagation of waves in the ionosphere. The methods now in use indicate that the reflected signal resulting from a single pulse incident on the ionosphere consists frequently of a doublet the components of which are separated by a small time-interval. The reflected components are apparently electrically polarised waves of opposite rotational sense.

Machine Mining and Labour Problems

ALTHOUGH machine mining has made comparatively rapid progress during recent years, there is still room for a great advance in mechanisation. In a paper by Mr. J. Dooley, printed in the *Mining Electrical Engineer* of February, it is stated that in Yorkshire, which is one of the most progressive coal fields of Great Britain, only about one third of the coal produced is cut by machines and only about a sixth is loaded on to conveyor belts. There are a few coal seams from which coal simply rolls over into the 'tub', and it would be quite unnecessary to 'machine-cut' the faces of these seams. But even in these cases mechanical loading could be economically applied by means of conveyors of suitable design. Another economic factor which has to be taken into account is the possibility of a shortage of suitable labour in the near future. This question may rapidly become acute as newer and more attractive industries and interests arise to attract the boys and young men who would otherwise automatically enter the pits. It is true that to some extent machines displace labour temporarily, yet the position may be reversed, and collieries be compelled to put in machines because sufficient labour is not available. It is essential for colliery managers to get to work with new ideas, and arrange and organise systems of work so that full advantage be taken of the existing types of machinery. There are machines already in use designed to carry enormous loads in supporting the roof and protecting other machines employed for cutting, loading and conveying coal simultaneously. American collieries have very large outputs per 'man shift', far in advance of anything ever attempted in Great Britain.

Pacific Science Association

THE Fifth Pacific Science Congress of the Pacific Science Association was held in Canada in 1933 under the presidency of Dr. H. M. Tory, president of the National Research Council of Canada. The Congress, which was held under the auspices of the National Research Council of Canada and through the generosity of the Government of Canada, was a notable achievement in the history of the Association. Representatives of no less than thirty-two countries attended the Congress, while the total number taking part in the meetings exceeded four hundred. The meetings were held in Victoria, B.C., on June 1–4 and in Vancouver, B.C., on June 5–14. The success of the Congress has now been crowned by the publication of the *Proceedings* in five large volumes amounting to more than four thousand pages (Toronto: University of Toronto Press; London: Oxford University Press, 1934. 5 vols. 84*s*. net). These volumes form a noteworthy summary of scientific knowledge from many aspects contributed by research workers of those countries bordering the Pacific Ocean. It is clearly not possible to review the contents of these volumes, but mention should be made of the lavish hospitality extended to the members and participants by the Canadian authorities. The many social functions and the interesting excursions arranged for the entertainment of the visitors must have largely fulfilled one of the main objects of the Pacific Science Association, which is "to strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientists of all the Pacific countries". This alone should be sufficient tribute to the devoted care and energy given by those responsible for the organisation of the Congress.

German Science

A NEW quarterly review in English of German science has appeared under the title "Research and Progress" (Terramare Office, Berlin W 8), the editor being Dr. Karl Kerkhof. In the second number, which appeared in April, the articles are mostly geographical or cultural and historical in character. Prof. Erich von Drygalski discusses the effect of the polar regions on the history of the earth, dealing with the influence of currents of air from the pole from the physical, biological and human points of view, while Prof. Rudolf Spitaler considers the influence of shifts in the earth's axis on the production of earthquakes. Prof. Diedrich Westermann deals with a subject on which he has already made his views familiar to English readers—the changing African. The introduction of syphilis from the New World in 1493 is characterised by Prof. K. Sudhoff as a legend; it is suggested, however, that it may have spread by earlier contacts between the Old

World and the New through eastern Asia. No reference is made to recent research, which seems to point to its existence in Europe in early prehistoric times. The cults and ritual of myth are discussed in two articles, one by Prof. K. Th. Preuss on the significance of birth and death and their relation to initiation and other forms of ceremonial in which sex is an element, and the second by Prof. Gustav Hubener, who regards the position of the hero in early epics as based upon his power as an exorcist. Although this does not exhaust the list of contents, mention can be made here of one other paper only—Prof. Erich Haenisch's interesting suggestion that the vertical arrangement in Chinese writing is due to the form of the ancestral tablet. The papers are brief, running to two or three pages only, and the treatment summary and popular. As a counter to English comment on Germany's 'purge', it does not make a really impressive showing.

Studies of the Rarer Elements

IN his address as retiring president to the Chemical Society given on March 28 and entitled "Recent Researches on Certain of the Rarer Elements" (*J. Chem. Soc.*, p. 554, April 1935), Prof. G. T. Morgan outlined some of the most important advances which have been made in recent years in the study of the rarer elements. The British Empire is endowed with mineral resources to an extent unsurpassed by those of any other nation. It is obviously the duty of British chemists to undertake the systematic investigation of the rarer elements of the Empire, for it is certain that results of inestimable value will be forthcoming. Prof. Morgan is himself an outstanding leader in this kind of work and the results which he and his colleagues have accumulated form the main topic of the address. The extraction of germanium and gallium from Northumberland coal-ash has been started by Dr. G. R. Davies. Certain seams of Northumbrian coal give an ash containing up to 1 per cent of germanium and 0·05 per cent of gallium. The germanium is distilled out with acid as tetrachloride, whilst gallium trichloride remains in the still. A diagram of the apparatus is given. Rhenium has been extracted from Australian molybdenite by a lengthy process involving fractional volatilisation and ultimate separation with organic reagents such as 8-hydroxyquinoline and dipyridyl. The address concludes with some notes on the co-ordination compounds of ruthenium, amongst which is an ammine which dyes natural silk in red shades but is extremely difficult to isolate in a state of purity.

A Central Statistical Institute

DESPITE the immense increase in the amount of statistical material which has become available during recent years, investigators still lack the data for even approximate measurement of many of the most important economic forces. In an article in *World Survey* of May 1935 entitled "The Case for Economic Measurement", Mr. G. D. H. Cole pleads for the establishment of a Central Statistical Institute in Great Britain which would undertake the regular and prompt compilation and issue of this type of information, including regular surveys of production, prices, wholesale and retail trade, population movements and the like. He also advocates the publication of an annual "Progress of Britain Report" like that issued by the Government of India. The annual "Statistical Abstracts of the United Kingdom", it is true, go back nearly to the middle of the nineteenth century, and though greatly improved since the early issues, they have by no means been expanded in proportion to the development of the official *corpus* of statistics taken as a whole, and anyone who wants to collect the bare essentials of the current statistics in Great Britain has to work through much scattered material in numerous official publications. Mr. Cole also states that the publications of the Stationery Office on the subject are often expensive; while in most towns it is impossible to find any place where even the most important public documents can be consulted, and for private students or even small institutions, the cost of buying the bare minimum of requisite reports is excessive.

Prices of Biological Books in 1934

THE analysis of the cost of biological books in 1934, by John R. Miner (*Quart. Rev. Biol.*, Dec. 1934, p. 496), illustrates the significance of the devaluation of the dollar in affecting relative prices of American and foreign books. The estimates of cost are worked out in cents per page, the price of a foreign book being converted at the current rate of exchange, and the total number of pages upon which the calculations are based is 123,876. The only country in which prices have fallen is U.S.A. where (at 0·93 cents a page) there has been a drop of almost 9 per cent compared with 1933 prices. British Government publications have dropped from 1·39 to 0·89 cents a page and are now the cheapest of the lot apart from U.S. Government publications, which are issued at the amazingly low price of 0·18 cents a page; but the British Government sample was too small to be reliable. British books, on the other hand, have risen in terms of dollars by 45·5 per cent, French by 35 and German by 32. As to relative prices, British books now slightly exceed in price American books (0·96 against 0·93), France stands at 1·00 and Germany at 1·89 cents a page. As was noted in the report for 1933, the high prices of German scientific books and periodicals have proved a hardship to libraries and individual workers, and although as the result of a conference with German publishers some reductions in the prices of scientific periodicals have been made, evidently these reductions do not extend to scientific books.

Books on Horticulture

MESSRS. WHELDON AND WESLEY, LTD., of 2, 3 and 4 Arthur Street, New Oxford Street, London, W.C.2, have rendered a valuable service to gardeners by compiling a "Comprehensive List of Books on all Branches of Modern Horticulture, and a Selection of the Early Literature" (New Series, No. 39, 1935).

More than 1,000 titles are included in the forty-four pages of the pamphlet, and they cover every aspect of gardening, both practical and scientific. The section on early literature contains eighty-seven numbers, and includes the rare "Niewe Herball" by Dodoens, the first English edition of which was published in 1578. Sections on soils, manures, diseases, pests and propagation introduce the garden reader to well-chosen books on these subjects, whilst volumes describing vegetables, fruit, greenhouse produce, cacti, alpines, orchids, roses and other flowers are amply represented, as well as works on garden design and general practice.

The Green Flash

A NOTE in NATURE of May 25, page 866, gave a number of references to observations of the green flash and the conditions producing the phenomenon. In connexion with this subject, Dr. Raymond M. Bell, of the Pennsylvania State College, directs attention to Admiral Byrd's account of the phenomenon in the *National Geographic Magazine* (**58**, 186; 1930). Admiral Byrd observed the green colour for as long as thirty five minutes in Antarctica as the sun rolled along the horizon.

Announcements

A REUNION dinner of former students of the University of Leipzig will be held in London on November 2; further particulars will be announced later. Those who desire to attend should send their names either to Prof. W. Wilson, F.R.S., Bedford College, London, or to Prof. F. J. Wilson, Royal Technical College, Glasgow, as soon as possible, but not later than October 1.

THE International Congress on Malaria which was to have been held at Madrid next October has been postponed to the spring of 1936.

A SOCIETY OF EUGENICS has recently been founded at Bucharest under the presidency of Prof. G. Marinesco, professor of nervous diseases and electrotherapy in the University.

AN international radio station for the distribution of medical consultations to ships of every nation on the high seas has been founded at Rome with the Marchese Marconi as president of honour.

THE autumn meeting of the Iron and Steel Institute will be held in Manchester on September 16–18. Further information can be obtained from the Secretary, The Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

THE tenth international congress of the history of medicine will be held in Madrid under the presidency of Prof. G. Marañon on September 23–29, when the following will be the principal subjects for discussion: Arabian medicine in Spain; medicine in America during its discovery and colonisation; medical folklore in various civilised countries. The subscription is 75 pesetas each for members of the International Society of the History of Medicine and 100 pesetas for others. Further information can be obtained from the Secretariat of the Congress, Arrieta 12, Madrid.

AT the eighteenth annual meeting of the American Society of Ichthyologists and Herpetologists held at the Carnegie Museum, Pittsburgh, Pa., on May 2–4, the following officers were elected for the ensuing year: *President*, Clifford H. Pope, American Museum of Natural History; *Vice-Presidents*, Henry W. Fowler, Philadelphia Academy of Natural Sciences, Tracy I. Storer, University of California, E. H. Taylor, University of Kansas; *Secretary*, M. Graham Netting, Carnegie Museum; *Treasurer*, A. W. Henn, Carnegie Museum; *Editors*, Carl L. Hubbs and Helen T. Gaige, Museum of Zoology.

A GENERAL discussion on "Phenomena of Polymerisation and Condensation" has been arranged by the Faraday Society to be held in Cambridge, on September 26–28. The following workers from outside Great Britain have promised contributions and hope to be present: Dr. H. J. de Boer (Eindhoven); Dr. R. Houwink (Eindhoven); Prof. J. R. Katz (Amsterdam); Dr. O. Kratky (Vienna); Prof. H. Mark (Vienna); Dr. J. C. Patrick (Yardville, U.S.A.); Dr. G. Salomon (Zurich); Prof. R. Singer (Berne); Prof. H. Staudinger (Freiburg-im-Breisgau); Prof. H. I. Waterman (Delft); Dr. H. B. Weiser (Houston, U.S.A.); Prof. G. S. Whitby (Ottawa). It is also hoped that Prof. A. Favorskij (Leningrad), Prof. F. Medredjev (Moscow), Prof. K. H. Meyer (Geneva) and Dr. W. Carothers (Wilmington, U.S.A.) will be present. Further details can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior assistant, a research investigator and a junior research investigator to the British Non-Ferrous Metals Research Association—The Secretary, Regnart Buildings, Euston Street, N.W.1 (June 17). A lecturer in bacteriology in the University of Birmingham—The Secretary (June 22). A civilian educational officer in the Royal Air Force Educational Service (engineering or physics)—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (June 24). An assistant lecturer and demonstrator in botany in University College, Southampton—The Registrar (June 26). A temporary assistant in farm economics in the Department of Agriculture for Scotland—The Secretary, Department of Agriculture for Scotland, Queen Street, Edinburgh, 2 (June 29). Mechanical engineers and chemists for the Supply Board Technical Establishment under the Director of Ordnance Factories—The Under-Secretary of State (C 5), The War Office, London, S.W.1 (July 1). A professor of mechanical engineering in Osmania University, Hyderabad—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 6). A professor of mathematics in the University of Aberdeen—The Secretary (July 23). A tutor in either biology or the history of science in the Harlech Residential College for Adult Education, North Wales—The Warden.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 1002

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Passage of Helium through Compact Solids

IN NATURE of January 5, p 30, experiments were described showing that gelatine, celluloid and cellophane, like vitreous silica, will allow helium (but not air) to pass fairly freely through them at the ordinary temperature I have since found that vitreous boron trioxide has the same property. Vitreous borax, like the common glasses, does not possess it

As regards the behaviour of single crystals, I have tried a number of them, and have failed to prove the passage of helium at the ordinary temperature through any The provisional positive result with a beryl crystal before reported has proved to be erroneous, and is withdrawn

Experiments on crystals at a higher temperature are in hand. The known facts about the extraction of helium from minerals by heat suggest that a positive result is likely

RAYLEIGH

69 Cadogan Square
May 31

Isotopic Constitution of Platinum and Rhodium

THE analysis of the platinum ions from a high-frequency spark[1], using a new spectrograph, shows that this element consists of five isotopes with masses 192, 194, 195, 196, 198 The middle three form a triplet of almost equal strength, while the heaviest is decidedly weaker and the lightest very faint.

In the new spectrograph, the ions are deflected through 90° in a cylindrical condenser and are then further deflected through 180° by a magnetic field The distances and radii of curvature are arranged so as to bring a divergent bundle of ions with small differences in their energies to a focus at the centre of the photographic plate With a slit 0 1 mm wide, images of about the same width were obtained, giving a resolving power of 1 in 1,000 Using an alloy of platinum with 10 per cent rhodium as electrodes of the spark, the isotopes of platinum were widely separated, and the doubly charged platinum ions could be compared directly with the rhodium isotope at 103, previously observed by Dr. Aston No companion to the latter could be found even though the main line was much over-exposed. From its position we would expect platinum to have very nearly integral masses. On this assumption the average of six photographs gave an atomic weight of 102·92 ± 0·03 for rhodium, in approximate agreement with the chemical atomic weight

A J. DEMPSTER

University of Chicago.
May 23.

Absorption of Slow Neutrons

FERMI and others[1] have shown that slow neutrons are very strongly absorbed by various elements, they found that the absorption curves are by no means exponential The arrangement used in their experiments was to put the flat test-piece between sheets of the absorber inside a hole in the paraffin block that contained the source Experiments that we have made under similar conditions have led to the same result, the absorption observed being the same whether the activation of the 20 sec or the 2 min period of silver is taken as measure of the intensity.

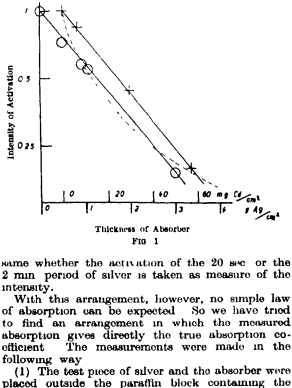

FIG 1

With this arrangement, however, no simple law of absorption can be expected So we have tried to find an arrangement in which the measured absorption gives directly the true absorption coefficient The measurements were made in the following way

(1) The test piece of silver and the absorber were placed outside the paraffin block containing the source, which consisted of 150 mC. radium emanation mixed with beryllium If the test piece is put inside a hole in the paraffin, a neutron which has already crossed the test piece once can be scattered back again so as to return to the test piece, so that the effective thickness of the absorber becomes greater than the measured value In our arrangement no neutron can reach the test piece a second time after having passed through it once

(2) The paraffin block was shaped so that there was no wax in the direct path (about 20 cm) between the source and the test piece; the activation produced by fast neutrons could therefore be allowed for, by subtracting the activity produced in the absence of paraffin

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[1] NATURE, 135, 541, April 6, 1935

(3) The absorbers consisted of hollow spheres or cylinders so large compared with the test piece in the centre that those neutrons which reach the test piece must traverse the absorber nearly normally.

The absorption of cadmium and silver was measured The logarithms of the measured intensities are plotted in Fig. 1, against the thickness of absorber. The absorption is in both cases exponential so far as the observations extend, that is, down to one fifth of the original intensity. The half values are 1 25 gm /cm ^{2} for Ag and 24 mgm /cm ^{2} for Cd Fermi's values for cadmium are given as the dotted line in Fig 1

This result, that slow neutrons are absorbed exponentially under suitable experimental conditions, suggests either that the active neutrons are of fairly homogeneous speed or that, in the region of velocity of the neutrons concerned, the nuclear cross section does not depend appreciably on the velocity of the neutrons

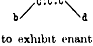
W. EHRENBERG
HU CHIEN SHAN

Birkbeck College,
London, E C 4
May 30

[1] *Proc Roy Soc*, A, 149, 522, 1935

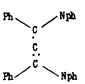
Experimental Demonstration of the Allene Asymmetry

WE have succeeded in verifying the prediction made by van't Hoff in 1875, but hitherto unverified, that unsymmetrically substituted allenes,

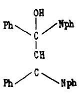


would be found to exhibit enantiomorphism

The difficulty in demonstrating the association of optical activity with this structural type lay chiefly in the synthesis of a substituted allene with suitable salt-forming groups This difficulty can be avoided by the employment of asymmetric catalysis, and we have by this means obtained diphenyl di α-naphthyl allene (I)



I



II

in optically active forms (It has long been recognised that the dissymmetry of van't Hoff's type persists when *a* is identical with *c* and *b* with *d*)

The different forms of the allene were obtained by dehydration of the alcohol (II). The inactive form, produced by ordinary methods of dehydration, melts at 242°–244°. When the dehydration is carried out catalytically by heating with *d*-camphorsulphonic acid in benzene solution, there is produced, together with the inactive form, a certain proportion of a powerfully dextrorotatory isomeride with $[\alpha]_{5461}$ + 437° This optically active modification is much more soluble than the inactive allene and can be isolated in well-formed crystals melting at 158°–159°. When *l*-camphorsulphonic acid is used as the catalyst the corresponding lævorotatory enantiomorph with $[\alpha]_{5461}$ − 438° is formed

It was shown that these optically active isomerides of m p 158°–159° were actually enantiomorphous forms of the allene by mixing their saturated solutions at the ordinary temperature, when the inactive (racemic) allene of m.p. 242°–244° crystallised

The active forms have very considerable optical stability, though they gradually lose their activity when heated above 160°.

PETER MAITLAND
W H MILLS

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Cambridge May 18

The Straight Chain- and the Many Membered CH_2 Ring-Molecule

THE heats of combustion of a CH_2 group are the same in a normal and in the cyclo molecule, except the first members of the two series Almost the same holds for the refractivities if the very small differences in the cyclo series are disregarded From these two facts it must be concluded that the carbon-carbon and the carbon-hydrogen distances are the same in both series, and that the whole electronic configuration of an individual CH_2 group is nearly identical in both structures

Yet it is found that there is a marked difference in the densities or molecular volumes in the two series when these measurements are made at temperatures near the melting point This fact was first noticed and has been fully discussed by L Ruzicka and his collaborators A summary of their systematic work has recently been published in the *Journal of the Society of Chemical Industry* (January 1935)

Owing to the kindness of Prof Ruzicka, who supplied me with a number of these cyclo compounds, I was able to measure their molecular volumes by means of X-rays, the substances being in the solid state[1] In this paper I came to much the same conclusion as Ruzicka and his co-workers, and ascribed the high density of the cyclo compound as due to the strain produced by the bending of the chain into a ring

Looking into this matter since, I calculated the molecular volume of a CH_2 group both in a straight chain and in a cyclo compound, using for this calculation some earlier measurements on hydrocarbons at low temperature[2] These are the figures·

Average volume of a CH_2 group in the cyclo hydrocarbon $C_{12}H_{24}$ and in the *n* - $C_{12}H_{26}$, in 10^{-24} c c

Temp (abs)		cyclo		normal
90°	solid	23 3	solid	23 7
290°	solid	24 6	liquid	28 8
330°	liquid	27 6	liquid	30 0

($C_{12}H_{24}$ has a particularly high density in the whole series of cyclo compounds)

The striking fact is that the molecular volumes become identical at a low temperature; or in other words, the two substances differ only in their coefficient of thermal expansion This is not surprising. Although the CH_2 groups in both series are nearly the same, there must be a difference in their mobility, since one group is part of a chain with two free ends and the other group is in a closed chain which as a whole must have a higher rigidity.

A. MÜLLER.

Davy Faraday Laboratory,
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May 27.

[1] *Helvet Chim Acta*, 16, 155, 1933
[2] *Proc Roy Soc*. A, 127, 417; 1930.

An Ancestral Habit in a Sea-Urchin

THE heart-urchin *Echinocardium cordatum* is one of the most abundant species in the littoral fauna of the British Isles. It is found everywhere where smooth sandy beaches occur and it is distributed all over the bottom of the North Sea to the Danish coast. Its normal mode of life is to excavate a burrow for itself situated about 6 inches below the surface of the sand; this burrow is connected by a vertical shaft with the surface. The roof of the burrow is supported by a cockscomb-like crest of curved spines and the surface of the urchin is quite unpolluted by the sand which forms the wall of the burrow. Through the vertical shaft the urchin protrudes the long tube-feet which belong to the anterior ambulacrum; the discs terminating these tube feet are fringed with fingers so as to resemble small sea-anemones and with these the urchin sweeps up small animals lying on the bottom. So effective are they, that where *Echinocardium* abounds no mussels can exist; for as soon as the young mussels metamorphose from free-swimming larvæ, they are seized by the tube-feet of the buried *Echinocardium* and conveyed to its mouth.

The heart-urchin is capable of deserting its burrow and moving elsewhere to dig out a fresh one; but, so far as hitherto observed, its movements are carried out by the spines of its under surface, which are curved and end in spoon-shaped tips; obviously tube-feet could give little support in shifting sand.

The habits of the regular sea-urchin form a complete contrast to those of the heart-urchin. When opportunity is afforded of seeing the regular urchin in its natural surroundings, it is easy to see that it is pre-eminently a climber. It is found clinging to vertical faces of rock; it uses its long tube-feet as cables to pull it forwards whilst it steadies itself with its spines. Gifted with sharp razor-like teeth, it gets its living by scraping the short algal growth from the rocks on which it climbs. In my opinion, this climbing habit explains the evolution of the globular sea-urchin from a flattened starfish-like ancestor.

During a recent visit to Plymouth as a member of the committee which annually inspects the biological station there, I observed a half-grown *Echinocardium cordatum* confined in a square glass tank with vertical walls. To my amazement I saw that the animal had climbed one of the vertical walls, to which it was clinging by its tube feet, using these in the same manner as does the regular sea urchin.

Now all the evidence available points unequivocally to the conclusion that the heart-urchins have sprung from ancestors which, did they live now, would be regarded as regular urchins, so that we find buried deeply in what we may call 'psychic constitution' of the heart-urchin an inherited habit which, in the normal circumstances of its life, can rarely if ever be called into play, but which is nevertheless there and can function if the necessity for it arrives. Truly the inner constitution of this, as of all other animals, is made up of layers of habits!

E. W. MACBRIDE.

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Hants.
May 22.

Mixed Agglutination

IF a mixed suspension of sheep erythrocytes and a certain strain of Friedländer bacilli are made to agglutinate in the presence of both homologous antisera, what appears to be a novel form of agglutination—*mixed* agglutination—is observed. The clumps obtained under our conditions by thus simultaneously mixing two antigens and their antibodies in the same system are seen to consist not only of red cells adherent to red cells, and not only of bacilli adherent to bacilli, but also of bacilli and red cells adherent to one another. Control experiments with only one antiserum do not yield the mixed clumps, although occasionally a red cell or two may be seen adherent to the specifically agglutinated organisms, and vice versa.

It is planned to carry out similar experiments on other systems composed of two or more antigens and their respective anti-sera to ascertain if this phenomenon, as yet observed only in these preliminary experiments, is a general one. If the phenomenon is a general one, and if the point of view be accepted that sensitisation involves more or less of a surface deposit of anti-body globulin, it would appear that under certain conditions the part of the globulin molecule related to its specific properties is unessential for the process of agglutination.

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April 15.

Mechanism of the Pasteur Effect

THE following recent observations are relevant to the aerobic glycolysis and increased oxygen uptake[1] caused by addition of potassium salts to glucolysing brain slices, and also to the mechanism of the Pasteur effect.

Potassium chloride causes increased oxygen uptake in brain tissue with substrates other than glucose, for example, fructose and lactate, which cannot form lactic acid in nitrogen. Here no aerobic glycolysis results. Further, the rate of disappearance of lactate ($-Q_{L}^{O_2}$) is markedly increased by potassium.

Substrate	Without *M*/10 KCl		With *M*/10 KCl	
	Q_{O_2}	$Q_{L}^{O_2}$	Q_{O_2}	$Q_{L}^{O_2}$
Fructose 0.2 per cent	− 6.9 − 6.5	+ 0.2 + 0.2	− 10.5 − 9.2	− 0.1 − 0.65
Lactate 0.2 per cent	− 9.2 − 9.1	− 1.75 − 1.4	− 14.05 − 14.7	− 5.25 − 4.10

Again, potassium chloride causes aerobic glycolysis in the case of mannose[2], which can form lactic acid anaerobically.

The following theory is put forward to explain the co-existence of aerobic glycolysis and increased respiration with glucose, as well as the sparing action of oxygen on the glycolysis of normal cells. Oxygen may be supposed so to affect the cell permeability as to set a limit to the rate at which glucose can reach the cell enzymes. Inhibition of the Pasteur effect consists in a removal of this limitation, so enabling more glucose to reach the intracellular enzymes. This increased permeability results in an increased rate of both respiration and lactic acid formation.

The view that agents which inhibit the Pasteur effect do so by affecting cell permeability is readily acceptable in the case of potassium It is an old suggestion[3] that metal ions may affect cell surfaces by converting a water-in oil emulsion to an oil-in-water emulsion The fact that the inhibition of the Pasteur effect, brought about by potassium, is reversed by calcium is a point, on the whole, in favour of such a hypothesis, thus we found that a $Q_L^{O_2}$ of 16 5 in presence of glucose and $M/10$ potassium chloride was reduced to 2 0 by addition of $M/20$ calcium chloride, though addition of sodium chloride in the same concentration did not reverse the potassium effect. Further, we found that rubidium and cæsium had a similar effect to potassium in causing aerobic glycolysis Values of $Q_L^{O_2}$ on the same brain in the presence of $M/10$ concentration of the chlorides of these metals were, for potassium 10 3, for rubidium 10·35 and for cæsium 5 85, while for magnesium a value of 2 9 was obtained

In view of the present evidence, we consider that in the absence of oxygen, the permeability of the cell is so altered (see Cowan[4]) that the enzymes are completely accessible to glucose The enzymes are saturated, and the rate of lactic acid formation becomes maximum In the presence of oxygen the enzymes are much less accessible to the substrate Glucose reaches the enzymes relatively slowly, and lactate is either not formed, or is formed at a slower rate than that at which it can be oxidised If lactate be the substrate added, it too can only slowly gain access to the enzymes, and therefore its rate of removal is relatively low except when potassium is added

KENDAL DIXON
ERIC HOLMES.

Sir William Dunn Institute of Biochemistry,
Cambridge
May 15

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[1] Ashford and Dixon, *Biochem J*, **29**, 157, 1935
[2] Dixon, *Biochem J*, **29**, 973, 1935
[3] Clowes, *J Phys Chem*, **20**, 407, 1916
[4] Cowan, *Proc Roy Soc*, B, **115**, 216, 1934

Statistical Aspect of the Production of Primary Lesions by Plant Viruses

AN analogy has frequently been drawn between the production of bacterial colonies on artificial media and of primary lesions on the leaves of susceptible host plants inoculated with an extract of virus-diseased tissues. In a recent paper, Youden, Beale and Guthrie[1] have carried this analogy one step further, and have suggested that the relation between the numbers of lesions and the relative concentrations of virus particles in the inoculum may be described in the same way as the relation between the numbers of bacterial colonies and the concentration of bacteria in the plated suspension Their equation takes the form:

$$y = N(1 - e^{-ax}),$$

where y is the number of lesions given at any concentration x of the virus, N represents the maximum lesions obtainable, and a is a constant

There is no reason to doubt that this equation is fundamentally correct, but there is good reason to doubt whether it applies to the majority of the dilution data which they have collected from various published papers and cited in proof of agreement (Ref. 1, Table II). If the values for low dilutions are fitted by this equation, the calculated values for higher dilutions are almost uniformly too small, and sometimes, as in the following case quoted by Youden, Beale and Guthrie from a paper by Samuel and myself[2], the differences are far beyond the limits of the experimental error

Lesions observed	12144	7470	4314	3363	2010	1003
Lesions calculated by Youden, Beale and Guthrie	11756	8572	3932	1415	467	150

The standard error of the total 1003, for example, is 79 4 Youden, Beale and Guthrie, in transcribing this series, omitted the two figures for the weakest concentrations, they are 477 and 234, and the calculated values would be approximately 48 and 15

As proof of agreement, these authors plot values of $\log(N-y)$ against concentration and show that, in the cases they choose for the purpose of illustration, the values fall approximately on a straight line This gives a misleading idea of the goodness of fit, as when N is much greater than y, y may vary widely without causing wide departures from a straight line About two years ago, attempts were made to apply this equation to a series of experiments performed by Mr Samuel and myself in which samples of crude juice from plants diseased with tobacco mosaic were diluted with distilled water. The more accurate the experiment and the wider the dilution range it covered, the more apparent it became that under our conditions the relation of lesions to concentration could not be described in these terms. For some time I have been working to find under what conditions the equation does apply, and to what departures are due, briefly, it applies only to very carefully purified suspensions of virus. Distortions exist with samples which are carried to that stage of purification where only slight pigmentation remains

It is doubtful, therefore, what meaning can be attached to the constants calculated by Youden, Beale and Guthrie from equations that fit only portions of the dilution series, and until this has been decided the equation derived from the Poisson series should not be used for the correction of results obtained by the primary lesion method except with very carefully purified samples of viruses

J G. BALD
(Australian Council for Scientific
and Industrial Research).

Botany School,
Cambridge.
May 13

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[1] Youden, Beale and Guthrie, *Contrib Boyce Thomson Inst*, **7**, 37, 1935
[2] Samuel and Bald, *Ann. Appl. Biol.*, **20**, 70, 1933.

The Dyestuff Industry

I FEAR that Prof. Armstrong is very angry with me (NATURE, June 1, p 907); for with him such phrases as "management and commercial side", "commercial community", "commercial outlook", "commercial mind" are of course terms of comprehensive opprobrium, and lie at the opposite end of the scale to such mellifluous, desirable and creditable phrases like "true technical leadership" Perhaps after all I do deserve his anger, for he says "I have more than once discussed the situation, most recently in an article in the *Pharmaceutical Journal*". As I regularly read most of what Prof. Armstrong writes, this was not news to me, although I have not yet reached the stage when I can, just because Prof. Armstrong says so, accept it as the complete and absolute faith

It may be that I must both live and die a rebel But I do think it high time that someone might at least call a halt to this fifty years merciless (and to my mind, unfair) belabouring of the commercial man for the loss of a great and scientific industry, and it accords with poetic justice that this should be done by one who, if he cannot claim to be a chemist, cannot claim to be anything at all

However, I am not unduly alarmed because Prof Armstrong does agree with me that the pioneers *did* leave the industry, and that the industry *did* languish, and, mark you, they were captains of their own industry—in those days "the commercial and management side" had not even arrived Prof Armstrong further tells us that when they, Perkin and Nicholson, retired, "the fate of the industry was sealed already in 1865". Why ? I can only gather from his letter that it was due to Perkin being 'without imaginative power" and in the case of Nicholson because *his* partners "would not move with the times"

May I hope that when Prof Armstrong reads a lecture which he did not hear, he may find that he is not in such complete disagreement "with the side represented by Mr Cronshaw—the managerial and commercial side" as a hasty pen led him to suppose

I observe that Prof. Armstrong, obviously warming to his theme, says that "History cannot be written at a distance from the events by those who have had no direct knowledge of the period considered, and of the men concerned", a dictum that would have robbed the world of a large number of its greatest historians It automatically robs chemistry of an attractive and provocative historian except for the space of four score years

In his last paragraph, Prof Armstrong has some hard words to say about the industry I fear he has not the necessary feeling for the conditions prevailing No one who is in a position to know shares his view, but this cannot be a novel situation for Prof Armstrong In one thing his letter completely persuades me that it is possible to have "direct knowledge of the period considered and of the men concerned" and still not write history However, for that we shall have to wait and see

CECIL J T CRONSHAW.

Dyestuffs Group,
Imperial Chemical Industries, Ltd
June 5

Prediction of Earthquakes

THE appalling havoc wrought by earthquakes in India during the past eighteen months has attracted wide attention to the fact that, so far, science has failed completely to devise any means of providing a warning of the imminence of such disasters. At a lecture on Indian earthquakes, given at the Royal Society of Arts in March of last year[1], this fact was deplored both by the lecturer, Sir Edwin Pascoe, and by Sir Thomas Holland, both of whom have held the position of director of the Geological Survey of India. In referring to the Bihar earthquake of January 1934, Sir Thomas Holland emphasised that "There was no warning whatever and that destruction was sudden and complete in a few minutes". The same words apply equally well to the more recent disaster of Quetta and, in fact, to most major earthquake disturbances The value of a warning, in the saving both of life and property, can scarcely be exaggerated, even if it is of a general character and comes long ahead of the actual disturbance.

As there are no reasons for supposing that this long-felt want will always lie beyond the powers of science, it is reasonable to suggest any line of approach which conceivably might lead to the desired end One of these, which apparently has never been considered, lies in the possibility that anomalous electrical potentials may arise in the ground during the building up of the stress conditions which ultimately result in an earthquake Electrokinetic phenomena may reasonably be looked for under such conditions, and if they could be detected and the resulting ground potentials proved to be measurable, then it is not unlikely that when mapped they would afford a clue as to the stress distribution in the district examined In fact, to anyone with a fertile imagination and familiar with some of the recently developed methods in the electrical branches of applied geophysics, it seems just conceivable that the position of an epicentre might be predetermined in this way Furthermore, the changes in the potential gradients with time might provide evidence as to the imminence of an earthquake disturbance

A virtue which may be claimed for this tentative suggestion is that it is one which could be tested without great difficulty and, assuming that telegraph or other land lines could be used for the measurements the expense would be relatively small Periodical measurements of the potential differences existing between points on a network of stations in an area subject to seismic disturbance might well provide information of real value

A B BROUGHTON EDGE

London
June 4

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[1] *J Roy Soc Arts*, **82**, No 4247, April 13, 1934

Critical Phenomena in the Oxidation and Self-Inflammation of Hydrocarbons

MESSRS NEUMANN and AIVAZOV direct attention[1] to the negative temperature coefficient of the combustion of hydrocarbon mixtures under certain conditions; this phenomenon, which has also been referred to by Pease[2] and by Beatty and Edgar[3], seems well established. The explanation given in the letter is a formal presentation of the views which have been put forward in various communications dealing with hydrocarbon combustion, the peroxide theory and knock in engines The step $A \rightarrow B$ is the normal process whereby the hydrocarbon is oxidised to aldehyde

The peroxide theory postulates that this process takes place via an intermediate peroxide which in normal circumstance may be written $RCH_3 + O_2 \xrightarrow{k_1} (RCH_3O_2) \xrightarrow{k_2} RCHO + H_2O$, but in favourable circumstances the intermediate step can give rise to chain branching and hence eventually to ignition in a lower temperature range. The conditions for maximum concentration of X or RCH_3O_2 are as indicated in Neumann and Aivazov's letter The conditions in which chain branching occurs are particularly important in connexion with the phenomena of knock; thus the presence of antiknocks lower the effective concentration of X, while the efficacious proknocks all seem to disrupt in such a way as to lead to a similar type of branching The mechanism whereby this branching leads to reformation of X and thus autocatalysis is discussed in a forthcoming publication

A EGERTON
A R UBBELOHDE

Clarendon Laboratory,
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[1] NATURE, **135**, 665, April 27, 1935
[2] *J Amer Chem Soc*, 1929 and 1934
[3] *J Amer Chem Soc*, **56**, 102, 1934

Electronic Energy Bands of Solid Copper, Nickel, Cobalt and Iron

DURING the course of experiments on the soft X-radiations of the elements copper, nickel, cobalt and iron, evidence of electronic energy bands has been obtained The examination of the radiations was made with a tangential grating vacuum spectrograph, and the lines under investigation were the group comprising the L series These, and especially the L_a line, have been obtained with considerable intensity Examination of the plates has shown a blackening on the long wave side of L_a Microphotometer records demonstrate that this is due to the fact that the line, although possessing a comparatively sharp peak, drops to zero very slowly on this side, and extends almost to the L_η line Making an allowance for the slit width of the instrument, the wave-length difference between the maximum of intensity of the line and the end of the 'tail' is, for copper, 1·21 A. This corresponds to the large energy difference of 77 5 electron volts The other three elements give energy differences somewhat less, but of the same order

The distribution in this band, namely, a fairly sharp short wave edge and a gradual diminution on the other side, suggests that the electrons in the initial state ($M_{\rm IV, V}$) may follow, very roughly, a Fermi distribution Such an explanation has been shown to be applicable to the K_a lines of a number of the light solid elements in which the initial state contains the valence electrons[1] In the present case the $M_{\rm IV, V}$ electrons are expected to be only partially bound, and some such distribution is therefore not altogether unexpected. It might be anticipated that the energy distribution of the $M_{\rm IV, V}$ electrons would resemble more closely that of a semi-conductor than that of a metal, and it is therefore satisfactory to note that there is a marked similarity in shape between the present bands and that of the K_a line of graphitic carbon

Taking the value 77·5 volts as the energy-spread in a Fermi distribution, the density of $M_{\rm IV, V}$ electrons in the metal may be calculated The result is too high, and corresponds in fact to the impossible value of 37 electrons per atom. It seems very likely that this is because the electrons are not completely free and cannot, normally, occupy the whole of the space in the lattice of the metallic crystal. Assuming that the number of electrons in the $M_{\rm IV, V}$ group of copper is 10, one obtains the result that these are free to move in 27 per cent of the volume of the crystal

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[1] Houston, *Phys Rev*, **38**, 1791, 1931 O'Bryan and Skinner, *Phys. Rev*, **44**, 602, 1933. **45**, 370, 1934.

The Phenomenon of 'Wings' as a Vibrational Raman Effect: A Correction

WE have shown in our previous experiments[1] that *the wings accompanying the primary scattered line* in liquids are mostly connected not with the rotation of molecules but with slow oscillations probably characteristic of the crystal lattice, and have pointed out that this phenomenon is thus connected with quasi-crystalline structure of liquids

In our note in NATURE of March 16, 1935, an error has crept in the data and photograph given for the crystal of naphthalene do not, in fact, refer to this substance, but to the p-dibrombenzene crystal In the case of naphthalene crystal, we have observed in the region of wings four Raman lines with frequencies . $\nu_1 = 45$ cm $^{-1}$, $\nu_2 - 73$ cm $^{-1}$, $\nu_3 = 109$ cm $^{-1}$ and $\nu_4 = 124$ cm $^{-1}$

We give in the following table the oscillation frequencies in the region of wings for crystals so far examined by us In all the substances studied, the benzene ring is present, and this may probably explain the appearance of frequencies common to some of the crystals

Crystalline substance		Frequencies in cm $^{-1}$				
Benzene	C_6H_6			62	104	
p-Dibrombenzene	$C_6H_4Br_2$	20	38		93	
Diphenylether	$(C_6H_5)_2O$	22	38	67	104	
Naphthalene	$C_{10}H_8$		45	73	100	124

We have studied the state of polarisation of new lines in the crystals of p dibrombenzene and diphenyl ether when the exciting light was unpolarised and polarised For different lines, various coefficients of depolarisation ρ were found, ranging from $\rho = 0$ to $\rho \approx 1$ For one line of p-dibrombenzene, $\nu = 20$ cm $^{-1}$, we have found $\rho \gg 1$ (in the case of polarised exciting light) Moreover, the coefficients of depolarisation for these lines depend upon the orientation of the crystal As in melting the crystal, these Raman lines broaden in a continuous spectrum around the primary line, it is not surprising that in many liquids the wings are strongly depolarised The depolarisation factor $\rho_n \to \frac{6}{7}$, which is to be expected for rotational Raman lines, found for the wings by some observers when unpolarised exciting radiation was used, can be regarded as a fortuitous coincidence

E GROSS.
M. VUKS.

Optical Institute,
Leningrad.
April 7.

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[1] NATURE, **135**, 100, Jan. 19; 431, March 16, 1935.

Distribution of Nuclear Mechanical Moments

TOLANSKY has suggested[1] that some importance might be attached to the relatively frequent occurrence of small values of those nuclear spins which seem to be due to neutrons, as compared with protons Even without a detailed nuclear model, an interpretation of the trend may be given

The nature of the effect of the exclusion principle on the average energy of similar particles is well known. The symmetry of states with opposite spin allows the particles to have a smaller average kinetic energy and energy of binding than they might have with parallel spins. This tendency (together with the favour bestowed by second-order effects on the spin with the greatest number of states) seems to be effective in making even numbers of neutrons and of protons have zero moments. But for protons this preference for opposite spins is opposed by the effect of the exclusion principle on the average repulsive electrostatic energy. If the spins are parallel, the particles avoid very small separations, thus decreasing the average Coulomb energy. Since the binding-type energy is apt to have no singularity at coincidence[2], the Coulomb energy may predominate at small separations and be relatively more important in determining spins than in questions of stability.

Although the actual states of the nucleus are probably an intricate mixture of the states of a representation of single-particle quantum numbers, their energy should be affected by the same trends as determine the order of states in a simple representation. If we consider a representation which includes orbital moments, the magnetic spin-orbit coupling (which is apt to be very strong, especially in heavy nuclei) introduces another tendency toward smaller moments for neutrons than for protons. If the spin gyromagnetic ratio is positive for protons and negative for neutrons, as seems likely from deflection data, this tends to make spin and orbital mechanical moments parallel for protons and opposite for neutrons.

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May 6.

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[1] NATURE, 135, 620, April 20, 1935.
[2] Majorana, *Z. Phys.*, 82, 137; 1933.

Production of Electron Pairs and the Theory of Stellar Structure

IN the discussion of problems of stellar structure, only the deviations from the perfect gas laws arising from degeneracy due to the exclusion principle for the electrons have so far been considered. In fact, as has recently been shown by one of us[1], these deviations involve far-reaching limitations on the possible stellar configurations under given conditions. Thus, it can be deduced from the form of the equation of state of a degenerate gas, taking due account of relativity, that in order that degeneracy should develop in any part of a star, the ratio β of gas pressure to total pressure at that point must satisfy the condition

$$\frac{960}{\pi^4} \cdot \frac{1-\beta}{\beta} < 1, \qquad (1)$$

and on the standard model, in which β is assumed to be constant throughout the star, this implies the existence of a critical mass

$$\mathfrak{M} = 6{\cdot}6 \bigcirc \mu^{-2}, \qquad (2)$$

($\bigcirc$ denoting the mass of the sun and μ the molecular weight) above which degeneracy cannot set in at all. A study of the equilibrium of completely degenerate gas spheres leads further to the result that there is an upper limit

$$M_3 = 5{\cdot}7 \bigcirc \mu^{-2} \qquad (3)$$

to the masses of such configurations; this affords the possibility, for stars of mass $\leqslant M_3$, of a course of evolution leading to complete degeneracy through intermediate stages comparable to the observed white dwarf configurations.

Quite another type of deviations from the perfect gas laws, however, arises from the existence of a definite distribution of positrons as well as electrons in equilibrium with temperature radiation, and in this note we desire to point out the bearing of this fact on the theory of stellar structure, and especially to indicate to what extent the conclusions summarised above have to be modified.

In the first place, no effect of the latter type can take place if the electron assembly is completely degenerate, for in that case all the states of negative energy will necessarily be occupied, which on Dirac's well known picture implies the total absence of positrons. For the theory of stellar structure this obvious remark has the consequence that, under white dwarf conditions, the influence of pair production on the configuration will be entirely negligible, and the possibility of evolution mentioned above, for stars of mass $\leqslant M_3$, can be upheld without modification.

More generally, the presence of an equilibrium distribution of pairs in addition to the 'excess' of electrons, which is proportional to the material density, will give rise to a correction term in the equation of state, and the effect of this term on the stellar structures may conveniently be surveyed on the standard model. It is found that for a fixed value of the ratio β, the correction increases with temperature, tending to a finite limit as the temperature tends to infinity. When the condition (1) is fulfilled, the maximum deviation from the perfect gas law is less than 2 per cent, which means that the effect is altogether negligible for stars of mass $< \mathfrak{M}$, in which degeneracy of the electron assembly is able to occur. For more massive stars, however, the correction term becomes increasingly important. Thus already when $1 - \beta = 0{\cdot}2$, corresponding on the standard model to a mass of $12{\cdot}6 \bigcirc \mu^{-2}$, the maximum effect amounts to 7 per cent. For very massive stars, say, of mass greater than $30 \bigcirc \mu^{-2}$, equilibrium configurations analogous to the white dwarf configurations for masses $< M_3$—but differing from the white dwarfs in that the deviations from the perfect gas laws now arise from the production of pairs and not from degeneracy—are therefore formally possible, and the question suggests itself: Do such configurations exist in Nature?

A detailed derivation of the results here summarised is to be published elsewhere.

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April 25.

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[1] S. Chandrasekhar, *Mon. Not. R.A.S.*, 95, 207–260; Jan. 1935.

Formation of Mercury Molecules

IT has long been known that mercury vapour is ionised by photons having energies considerably less than that corresponding to the ionisation potential of the mercury atom. Rouse and Giddings[1] showed in 1926 that mercury vapour is ionised by its resonance radiation, 2537 A. To explain this effect, Houtermans[2] suggested that an excited atom in the 2^3P_1 state of 4·9 volts energy may combine with a metastable atom in the 2^3P_0 state of 4·7 volts energy to form an ionised molecule and a free electron The energy available for ionisation of this molecule is (4 9 + 4 7) volts plus the heat of dissociation of the neutral molecule, which Winans[3] gives from band spectra data as 0 15 volt, making a total energy of 9 75 volts

The existence of mercury vapour molecules has never been demonstrated So far as chemical evidence is concerned, the ratio of the specific heats and vapour density determinations all show that mercury vapour is strictly monatomic Nevertheless, the occurrence of bands in the absorption and emission spectra of mercury vapour demand the presence of molecules

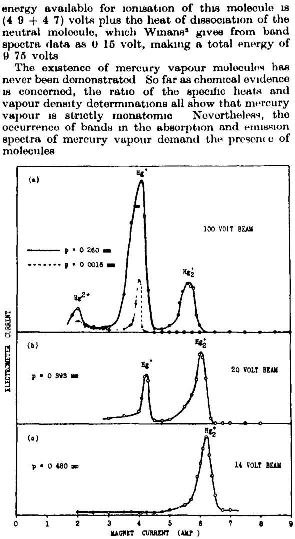

FIG 1

We have obtained definite evidence that diatomic molecular ions are produced in mercury vapour by electron impact The apparatus consists of an ionisation chamber containing a tungsten filament and a system of gauzes to accelerate the ions, which are magnetically analysed by the refocusing method The ionisation chamber can be maintained at different temperatures by an electric furnace

In the four curves shown in Fig 1, the total accelerating potential applied to the ions was 26 volts, six volts being used to draw the ions out of the region where they are formed, and another twenty volts to accelerate them into the analyser The broken curve in Fig 1 (*a*) shows the result obtained when the pressure of mercury vapour was 0·0016 mm of mercury The curve shows the presence of Hg^+ and Hg^{2+} ions, but no trace of a molecular ion. The continuous curve in Fig 1 (*a*) shows the result obtained for a pressure of 0·26 mm. of mercury. In addition to the atomic ions, there now appears a strong peak of Hg_2^+ ions The energy of the electrons producing ionisation was 100 volts for both curves. Fig 1 (*b*) shows the result obtained when the energy of the electrons was reduced to 20 volts, and Fig. 1 (*c*) for a beam of 14 volts. The curves are not drawn to the same ordinate scale

We see that as the energy of the electron beam decreases, the ratio of molecular to atomic ions increases, until at 14 volts the probability of atomic ionisation is so small that the atomic ion peak does not appear The fact that the molecular ion peak is still quite strong provides evidence for the theory that the molecular ions are formed by mutual attachment of two excited atoms or of an excited atom with a normal atom Measurements of the variation in height of the molecular peak with pressure indicate that it varies with the square of the pressure, which supports the above theory

This theory of the formation of the molecules clearly reconciles the chemical evidence of their non-existence with the band spectra evidence of their presence, for, unless the atoms are excited by light or electron impact, the vapour may remain monatomic This would require the neutral unexcited molecule to be unstable

Work is in progress to determine the variation with electron energy of the probability of formation of the molecular ion, and an investigation of the nature of the ion formed by *irradiating the vapour with the* resonance line 2537 A is also being undertaken A full account of these experiments will be published shortly

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April 29

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[1] Rouse and Giddings, *Proc Nat Acad Sci*, **12**, 447, 1926
[2] Houtermans, *Z Phys*, **41**, 610, 1927
[3] Winans, *Phys Rev*, **37**, 897, 1931

A Simple Method of Heterochromatic Photometry

As is well known, it is difficult to compare the intensities of lights of different colour We can tell when one is much brighter or much darker than the other, but values obtained for the point of balance by the direct methods differ widely amongst themselves It is consequently necessary to use the flicker photometer or the step-by-step method, in the latter method a series of lights of different colours intermediate between the colours to be compared is used, and the one end colour is compared with the first of these, the first with the second, the second with the third and so on Thus by reducing the difference in colour its disturbing effect is eliminated at the expense of some time and a cumulative error in the settings

I have found that lights of different colour can be compared easily by the ordinary Rumford or shadow photometer, if the rod is replaced by a partially transparent strip of glass. The method is most easily understood by the description of a particular case

A green inside-colour-sprayed 40-watt Osram lamp was compared with an 8 c.p. carbon lamp The matt glass screen of the photometer was at 0 cm. on the bench and the 8 c p. lamp at 380 cm. As rod I used first of all a strip of black paper mounted on a plate of clear glass, then a strip of fogged photographic film mounted on a similar plate, and finally a lighter strip of film mounted on another plate The two films transmitted respectively about $\frac{1}{16}$ and $\frac{1}{4}$ of the light incident on them. With the opaque strip the one shadow was green and the other orange; with the dark film, owing to the colours mixing, the difference in the colours of the shadows was not so pronounced, and with the light film it was less still

The same observer then made ten settings with the opaque strip, ten settings with the dark film, and ten settings with the light film The mean position of the green lamp was found to be at 162 2 cm , 169 9 cm , and 171 1 cm in the three cases, the probable errors of the means being 3 5, 1 6 and 2 9 cm respectively Thus the dark film gave the most accurate and the opaque strip the least accurate results It is obvious that for each pair of lights there must be a most favourable density for the film, for if it were perfectly transparent, there would be no shadows

It would be interesting to compare the accuracy of this method with that of the step-by-step method, but the comparison should be made by someone practised in the routine of the latter method

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Preparation of Colloidal Metals

IN the course of an investigation of the properties of thin dielectrics at high field strengths, an interesting phenomenon has been observed, involving the passage of substances through the dielectric, and leading to a method for the preparation of colloidal suspensions of liquid metals and alloys in semiconducting media

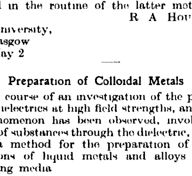

FIG 1 Diagram of apparatus for preparation of colloidal metals *A*, cellulose acetate cup , *B*, mercury bath , *C* and *D*, tricresylphosphate , *E* and *F*, metallic electrodes

Referring to the diagram, if a cup-shaped semipermeable membrane (for example, 0 1 mm thick), prepared from cellulose acetate and containing a semi-conducting liquid such as tricresylphosphate, is immersed in a bath of mercury, then an electric field of the order of 40 kv./mm. applied between the mercury and the tricresylphosphate will cause a copious flow of mercury through the cellulose acetate, the mercury remaining colloidally dispersed in the tricresylphosphate Either alternating or continuous voltages may be used, but in the latter case the polarity must be as shown. The mercury is covered with a thin layer of the semi-conducting medium, which serves to wet the surface of the cup as the latter is lowered into the mercury The suspensions made by this means have remained stable for considerable periods.

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Influence of an Electric Field on the Thermal Conductivity of a Solid

A SUBSTANCE with a permanent electric moment, such as bees-wax, was allowed to solidify in an electric field Afterwards it showed permanent greater thermal conductivity in the direction of the field, which had been applied before solidification occurred, than when it solidified without an electric field When an alternating field (50 cycles) was applied during the solidification, no alteration of thermal conductivity was noticed

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Cryolysis, Diffusion and Size of Particles

PROCEEDING from earlier considerations[1], the view was put forward recently that under the effect of freezing[2], particles of aqueous solutions of lyophilic biocolloids will undergo disaggregation or aggregation according to the prevailing concentration of the particles

To test the validity of this conclusion, further experiments were carried out with the object of determining the speed of diffusion of frozen (at - 17° and –79 C) and unfrozen solutions of sodium oleate, ovalbumin and polyacrylic acid Under our experimental conditions and with these substances, it could be shown that the effect of freezing causes in solutions of concentrations up to 1 per cent a disaggregation which could be measured by an increased speed of diffusion, and in solutions of concentrations higher than 1 5 per cent an aggregation manifesting itself by a decreased speed of diffusion in comparison with that of the unfrozen solutions There was only one exception observed This occurred in experiments carried out with freshly prepared solutions of polyacrylic acid, due to the fact that this substrate swells before it undergoes solution The more the concentration is diminished, the more the disaggregation prevails , and the more the concentration is increased, the more we can observe an aggregation which may lead up to a coagulation

These observations may afford further support to explanations given elsewhere for the transient increase in activity of frozen solutions of zymases, peroxidases and tyrosinase in connexion with the carrier theory[3] of enzymatic activity, may also explain the well-known effect of increased fertility of soil after a severe winter period, and may also have some bearing on the explanation of the behaviour of certain lyophobic colloids during the freezing of muscle plasma

Details of these experiments will be published shortly elsewhere

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April 15

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[1] F F Nord, NATURE, 120, 82 , 1927 *Trans Faraday Soc* 26 760 , 1930

[2] F F. Nord, *Science*, 75, 54 , 1932

[3] A P Mathews and T H. Glenn, *J Biol Chem* 9 51 1911

Products of Hydrolysis of Glycogen

ATTEMPTS in this laboratory to repeat the isolation of a trisaccharide from the products of hydrolysis of glycogen by glycerol extracts of muscle, as described by Barbour[1], have been unsuccessful, this is in agreement with the results recently reported by Carruthers[2]

In confirmation of Barbour's results, however, it was found possible to obtain a hydrolytic product with a reducing power equivalent to 30·33 per cent of the glycogen disappearing, and to obtain therefrom a phenyl osazone similar in crystalline form to that described by Barbour. Nevertheless, attempts at purification of the products of hydrolysis according to the methods described by Barbour were uniformly unsuccessful, and in view of similar negative results reported by Carruthers, investigation of this trisaccharide appears to merit further consideration

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[1] J Biol Chem, **85**, 29, 1929

[2] J Biol Chem, **108**, 535, 1935

Points from Foregoing Letters

LORD RAYLEIGH reports that vitreous boron trioxide, like vitreous silica, allows helium to pass through it Single crystals do not allow the passage of helium, and the report of a previous positive result with beryl crystal is now withdrawn

Using a new mass spectrograph and ions from a vacuum spark, Prof A J Dempster finds that platinum consists of five isotopes and that rhodium is single

With an improved experimental apparatus, W Ehrenberg and HuChienShan find that slow neutrons are absorbed exponentially by cadmium and silver, with production of radioactive elements This suggests that either the active neutrons are of fairly homogeneous speed or that a difference in speed does not greatly affect their chance of collision with the nuclei

Van't Hoff predicted sixty years ago that optically active substituted compounds could be prepared from the hydrocarbon allene By means of optically active catalysts, Dr Peter Maitland and Dr W H Mills have now succeeded in preparing stable dextro and lævorotatory allene derivatives

Dr A Muller has calculated from X-ray data the volume occupied by a CH_2 group in organic compounds of the straight chain and of the ring type The molecular volumes are identical at low temperatures, but as the temperature increases the CH_2 in a straight-chain compound occupies more space than that of a ring compound, possibly due to its greater mobility

Having observed a heart-urchin, *Echinocardium cordatum*, climbing on the vertical wall of a glass tank, a way in which it never acts in its natural surroundings, Prof E W MacBride suggests it is the result of a latent habit, inherited from ancestors more like the ordinary sea-urchin, which is pre-eminently a climber

Potassium salts increase the lactic acid formed in brain tissue, through the breakdown of glucose (in the presence of oxygen), and calcium opposes the effect produced by potassium K Dixon and Dr E Holmes believe this to be due to a change in the permeability of the cell membrane, which regulates the amount of glucose that reaches the cell enzymes, and that oxygen, like calcium, decreases this permeability.

J G. Bald finds that the relation between the concentration of virus particles introduced into host plants and the number of lesions produced, as expressed by the formula of Youden, Beale and Guthrie, applies only to carefully purified suspensions of virus

From measurements of the intensity of soft X radiations obtained from copper, nickel, cobalt and iron, and from the distribution of electronic energy deduced therefrom, F C Chalklin infers that the electrons in those elements are not completely free and cannot normally occupy the whole of the space in the lattice of the metallic crystal

In a previous communication dealing with the wings accompanying the primary scattered line in the Raman spectrum of liquids, Dr E Gross and M Vuks gave, as for naphthalene, certain data and a photograph obtained with a *p* dibrombenzene crystal They now correct this error, and give additional data concerning oscillation frequencies in the region of the wings, and the state of polarisation of new lines in crystals of *p*-dibrombenzene and diphenyl ether

Deviations from the gas laws may arise from the existence of a definite distribution of positrons and electrons in equilibrium with temperature and radiation From this effect S Chandrasekhar and Dr. L Rosenfeld deduce the possible existence of stars of very large mass and low luminosity, similar to the white dwarfs, owing their stability to different causes

By analysing magnetically the ions produced in mercury vapour at various pressures and voltages, Dr F L Arnot and J C Milligan show that molecular mercury ions exist. These are apparently formed only by the union of two atoms, of which one at least must be excited, a fact which may explain the conflicting evidence concerning the existence of mercury molecules.

When solutions of sodium oleate (soap) and other colloids are frozen, their particles, as shown by the speed of diffusion, aggregate if the concentration is higher than 1 5 per cent, and disaggregate if the concentration is less than 1 per cent, according to Dr F F. Nord and F E M Lange This may explain the temporary increase in activity of frozen solutions of certain enzymes, the increased fertility of soil after a severe winter, etc.

ERRATUM Dr. S. Mukerji writes to correct an error in the note on his letter in NATURE of April 6 He points out that the blood-sucking *Phlebotomus argentipes* is apparently the vector of *Leishmania donovani*, a protozoon which causes the malaria-like fever kala-azar in India *P. papatasii*, which is a vector of *L. tropica*, a protozoon morphologically identical with *L. donovani*, produces a localised skin infection popularly known as 'Oriental sore' or 'Delhi boil', and not the kala-azar fever.

Research Items

Celtic Mythology. In his Sir John Rhys Memorial Lecture for 1934, "Aspects of Celtic Mythology" (*Proc. Brit. Acad.*, 20. Separate, Oxford, Humphrey Milford, pp. 44. 3*s*. net), Dr. A. G. van Hamel puts forward the view that the mythical and heroic lore of the Celtic world in its succession of oath-strengthening gods, divine magicians, spirits of the land, and exemplary heroes, functioned as a guarantee of undisputed possession of the land. Gods are rare in the original sources of Celtic lore, and there is little evidence, except as reported from Gaul, of worship or sacrifice. The Immortals operated through magic, and the important element in relations with them is to avoid the infringement of taboo. Throughout Irish myth and legend runs the idea of protection of the land, which is especially ensured by knowledge of the local traditions. This gives power over the demoniacal forces associated with these localities. There is a graduation in the magic of protection. Highest come the 'divine magicians' who, while not actually gods, are immortals who protect the spirits of the land and the heroes such as Finn and his followers. Next come the spirits of the land, the Tuatha de Danann in Ireland and the Children of Llyr in Wales; and thirdly there are the heroes—Finn in Irish story, Arthur with his knights, corresponding in Wales; and with them are the kings to whom the actual function of 'protection' is entrusted. Although a great deal of folklore has gathered around both Finn and Arthur, it is improbable that either of them existed as men, although it is possible that in the latter a pre-existing function of 'protection' may have been attached to some prominent figure. The common elements in the function of 'protection', which is directed especially against magical forces, as seen in their exploits of slaying wild animals, especially boars, points to the mythical origin in the two instances. The significance of these heroes lies in their exemplary character. They are paradeigmatic, that is, the recitation of the legends in analogous circumstances ensures the like event. Hence the importance of the legends in education and the prominence of apprenticeship in the Druidical system.

Early Indian Iconography. In connexion with the figure of a squatting goddess on the underside of a terracotta figure of a toad, Mr. K. de B. Codrington has raised the question as to the derivation of certain hybrid forms, and of this figure in particular, in the early development of Indian iconography of the Mathura school (*Man*, May, 1935). The figure under consideration is in the Victoria and Albert Museum, South Kensington. It has no known pedigree, but almost certainly came from Mathura, the capital of the Kushan dynasty, and may be assigned to the early second century A.D. This derivation is supported by the treatment of the figure and the details of the beaded belt, necklace and hair, which are all in the native Indian tradition. On the other hand, the position of the goddess and her association with the toad point to the Baubo toad-goddess myth, which Dr. M. A. Murray has brought into association with the Sheila-na-gig; and the possibility that the present specimen was intended for toilet use recalls the further point that Baubo was a hand-maiden. Similar squatting goddesses, with hands touching the pudenda, are known in India, as, for example, the Bharhut goddesses and the railing figures from Mathura itself. The derivation from the Baubo tradition is more probable than an indigenous origin. Mathura was the scene of the development of Indian iconography, which at this time was just emerging. The Kushans had just made their way into India from Central Asia, and on Kanishka's coins the Indian Buddha figure rubs shoulders with a polyglot and hybrid Olympus in which appear Helios, Mao, Athro, Manaio and others, while at the same time the hybrid so-called Greco-Buddhist art appears in Central Asia, Afghanistan and Gandhara. If this figure be accepted as Baubo, it is one of the few, if not the only, example of a directly borrowed classical icon. The type recrudesces at Badami in the sixth century, and in the Elura *Kailasa* which was cut by architects from the south. In the female the posture is associated with the *Devi* in some of her manifestations as *Kali*.

Correlation of Physical and Mental Culture. Dr. L. P. Jacks in an essay in the *Hibbert Journal* (January 1935) deals with the new movement in physical culture, which aims at combining it with mental culture, and treating it as equally important. This synthesis, he says, would give physical culture its rightful place in education, the true end of which is not the acquisition of knowledge but the harmonious development of the whole man. At present this is realised only in the earliest stages of training—in kindergartens and Montessori schools, though the increasing importance attached to manual arts and the steady development of the Scout and Guide movements are hopeful signs. Exercises involving co-ordination and rhythmical 'patterned' movement are the chief features of the new physical culture, and it is obvious that what Carlyle called 'rhythmic human companionship' is essential for the welfare of the modern world. All our training must culminate in the interweaving of interests, if we are to bring order out of the present chaos, and humanity must change its habits as well as its opinions. There is at present no true 'social' system, but everywhere the need and desire for it. If a new type of education existed which developed in men's own lives the qualities they are always seeking outside, a solution might be found. To achieve this, trained leaders are essential, and a new profession should be created; then, if the quality of the human material does not decline, the world may be saved.

Beetles associated with Giant Lobelias and Senecios in East Africa. The giant species of *Lobelia* and arborescent *Senecio* constitute one of the most arresting features of the alpine floras of the isolated East African mountains. Both these genera of plants are represented there by a number of species, which are characterised by highly discontinuous distribution. It was, therefore, of exceptional interest to study the insects associated with these plants, and Dr. Hugh Scott's work on the Coleoptera (*Linn. Soc. J., Zool.*, 39; 1935) will be of value both to botanists and to zoogeographers. Not less than 49 species of beetles belonging to 13 families were found in the association. Only four of them are widely distributed, and can be regarded as casual visitors to the plants, while all others represent a highly special fauna. The genera of which this fauna is composed are partly widely distributed, while the others are peculiar and are very restricted in their distribution. These are probably specialised components of the Ethiopian fauna. The genus *Thamnurgus* was, however, previously known only from the Palæarctic region. The association between the insects and the plants may be a very ancient one, and the possibility of a parallel development of both may be considered. It is remarkable that, while the alpine species of *Lobelia* and *Senecio* are giant members of the respective genera, some of the beetles associated with them are also gigantic in comparison with their nearest relatives. It is also of interest that about 50 per cent of them are flightless.

Development of a Nemertean. J. F. Smith (*Quart. J. Micro. Sci.*, **77**, Pt. 3, 1935) describes the development of *Cephalothrix rufifrons*, a nemertean worm with a direct development. The spherical larva which issues from the egg is equipped with the rudiments of most of the adult organs. Owing to the confusion of the germ layers at the time of appearance of the mesoderm, the true nature of the secondary body cavity—whether it is a re-expansion of the blastocœl or a true cœlom—remains a matter of doubt. Gastrulation, effected by invagination, involves both endoderm and ectoderm, so that the blastopore is carried into the lumen of the gut, but this pore afterwards closes and the stomodæum and mesenteron are separated. Communication between these two parts of the gut is re-established later at or near the point of closure of the blastopore. A hind-gut is not formed until very late in development, and it is considered to be endodermal and not in the nature of a proctodæum, that is, not ectodermal. The formation of nephridia and of cerebral organs has not been observed and it is concluded that the latter are not present. The relationships of the various developmental types of the Nemertea are discussed and the conclusion is reached that there are two types of direct development, that the pilidium larva and the larva of Desor are more closely allied to the simpler direct, and least specialised type of development here described than to the other type of direct development seen in the Enopla.

Enteropneust Larvæ. G. Stiasny has published an account of the three Tornaria larvæ found in the Bay of Naples (*Pub. del. Staz. Zool. di Napoli*, **15**, Fasc. 1; 1935). Two of these, *T. Krohnii*, Stiasny, and *T. tergestina*, Stiasny, are recorded for the first time in that neighbourhood. They are provisionally identified as the larvæ of *Glossobalanus minutus* and *G. elongatus* respectively. The third species is shown definitely to be the larva of *Balanoglossus clavigerus*. An account is given of the biology of *G. minutus*. Stiasny has also described elsewhere several exotic Tornaria larvæ (*Verhand. Kon. Akad. Wet.* (Tweede Sectie), **34**, No. 2, 1934), of which two, *T. ramanujami*, a balanoglossid type of larva, and *T. uchidai*, a ptychodera type, are new species. Useful comparative tables are given of the diagnostic characters of the various species.

Growth and Tropistic Responses in Plants. Results of great interest are summarised by Prof. F. A. F. C. Went (*Biol. Rev.*, **10**, No. 2) in an account of the modern work on growth and tropisms carried on in his laboratory. In these investigations the coleoptile of oats and other grasses, a hollow cylinder in which the first seedling leaf develops, has been of much use. If the coleoptile is amputated, growth stops for about three hours owing to the removal of a substance (auxin) evidently produced in the young tip. This substance diffuses into agar and can thus be used to measure the effect on growth rate when applied to other seedlings. Innumerable experiments with this basis have been carried out in the last decade. Auxin *a* can be obtained from animal urine, where it is in turn derived from plants. It is an organic hydroxy-acid, while auxin *b* is a keto-acid, and a third growth substance discovered by Kögl is β-indolyl-acetic acid. These substances have no effect on cell division, but they increase the plastic extensibility of the cell walls. Auxin retards the growth of roots, probably by extending the transverse cell walls. It moves only from tip to base of the coleoptile, its movement being very rapid and only accounted for by the aid of protoplasmic streaming. Its production is inhibited by ethylene, which stops growth when present in very minute quantities. Many experiments go to show that both phototropism and geotropism can be explained by the movement of auxin in the plant. The shaded side gets more auxin than the illuminated side, and so grows faster. Negatively geotropic organs respond in the same way, but auxin inhibits the growth of roots and so gives positive geotropic curvatures. The relation of these responses to the statolith theory is not discussed.

Germination Experiments with Peas in Heavy Water. J. Brun and L. Tronstad have made several series of germination experiments with two forms of peas (*Pisum sativum*) at high, intermediate and low concentrations of heavy water (*Kgl. Norske Videnskabers Selskabs Forh.*, **7**, 171, 1934). Germination took place up to 40 per cent D_2O, but not from 50 per cent and upwards, which is in agreement with the results of G. N. Lewis with tobacco seeds. The alleged stimulation of growth at low concentrations could not be confirmed. The experiments were complicated by the formation of moulds, which took place up to the highest concentrations employed, namely, 98·4 per cent D_2O, as was found by K. F. Bonhoeffer and his collaborators.

Landslides in Japan. Prof. N. Miyabe has made a careful study of the distribution and phenomena of landslides in Japan (*Earthq. Res. Inst. Bull.*, **13**, 85–113, 1935). They have recently been most frequent in the prefectures of Nagano and Niigata on the north west side of the Main Island, the rocks in which they occur being chiefly shales. The rates at which they move vary widely, from about a foot a year to 100 feet an hour. In the above prefectures, they occur most frequently in April, with a smaller maximum in July; the former may be caused by the melting of the previous winter's snow, the latter by the heavy summer rains. Thus, the factors most effective in starting landslides are (1) destructive earthquakes and (2) water, rain and melted snow.

Dust Separation by Electrostatic Methods. The most efficient method of removing dust and water, tar and other liquid particles from air and gas appears to be the electrostatic method of which Sir Oliver Lodge was the pioneer more than fifty years ago. There are now some 3,000 electric filters employed in a wide range of industries, and 95–98 per cent of the total dust can be removed from the gaseous medium irrespective of the size of the particles In an article on the advantages of electrostatic methods of dust separation published in the March number of the *Electrical Power Engineer*, it is stated that the modern 'Lodge-Cottrell' service represents an association of the patents, researches and experience of several companies It includes the companies of Sir Oliver Lodge and his associates in Great Britain, Dr F G Cottrell in the United States and Dr Erwin Moller in Germany The basic principle consists of towers through which passes the fume-laden air In the towers is a series of vertical metal pipes called the collector electrodes which are connected with the earth The discharge electrodes are from points on rods or wires hung close to the collector electrodes These are connected with a high-tension power supply, and thus brush discharges take place from the points All the solid and liquid particles in the fumes are repelled against the collector electrodes and either fall down to the bottom of the tower into a hopper, or adhere to the electrode, the dust-free air or gas passing on To get rid of the adhering particles, motor-driven rapping hammers vibrate the electrodes and shake off the dust The high voltage is produced by a motor-driven rectifier operated by the ordinary electric supply Owing to recent improvements, the electric power required per million cubic feet of gas is less than two electric units (2 kwh)

Failure of Aircraft Propellers in Flight. With the ultimate aim of solving the larger problem of the causes of failures of aircraft propellers in flight, a very interesting series of investigations into the effects of vibration is being made at the National Bureau of Standards of the U S Department of Commerce The fatigue fractures usually exhibited suggest that such failures are due to alternating stresses set up by vibration and, in order to obtain data on this aspect of the problem, it was decided to ascertain experimentally the frequencies and stress distribution of non-rotating blades subjected to vibration, and to compare with these the values as computed by the usual theoretical methods (*J Research Nat Bur Stand*, Feb 1935) The experimental procedure consisted in applying, at the hub, controlled impulses and in measuring the amplitudes of tip vibration and the corresponding strains at various points along and across the blade From these observations, stress distributions for both fundamental and second harmonic modes were obtained For the calculation of the same values theoretically it was necessary to simplify the problem by making such assumptions as that all cross-sections are symmetrical and their axes of constant direction The very divergent results obtained would appear to throw doubt on the validity of such assumptions, particularly in their influence on frequency values It would seem almost necessary in such a case where the actual blade of experiment differs so materially from the theoretical blade of calculation to make a blade conforming to the theoretical conditions, and to compare the experimental results obtained from it, on one hand, with those of the actual blade, and, on the other hand, with the theoretical results which, properly, apply to it. Such an intermediate experiment would considerably help in determining the value of the investigation.

Tautomerism of Acetyl-Acetone. That acetyl-acetone exhibits tautomerism has long been discussed in text-books, but that several tautomeric forms of the compound can co-exist is less familiar (G T Morgan, *J Chem. Soc*, April 1935) Examination of its reactions with the tetrachlorides of selenium and tellurium have revealed its complex nature The univalent radical $C_5H_7O_2'$ is known to combine with many different elements to form three distinct types of derivatives, but selenium and tellurium differ from other elements in yielding derivatives of the bivalent radical $C_5H_6O_2''$ It is shown that whereas the *trans* monoenolic form reacts with other elements, selenium tetrachloride selects the *cis* form, whilst tellurium tetrachloride prefers the dienolic modification, ultimately yielding a *cyclo*telluropentanedione Further studies have revealed the existence of a deep-red bisarylditelluride, which is an analogue of azobenzene

Geometrical Transformations One of the most important topics in analytic geometry is that of Cremona and other rational transformations The older work in this subject has been summarised in the "Encyklopädie der mathematischen Wissenschaften" and Bulletin 63 of the National Research Council (Washington, 1928) Miss H P Hudson's "Cremona Transformations in Plane and Space" appeared in 1927 So much work has been done since these publications appeared that it has now been necessary for the National Research Council to issue a supplementary report ("Selected Topics in Algebraic Geometry", 2, Bulletin 96) After a list of twenty-one books (none earlier than 1924), there follow six chapters dealing respectively with curved and ruled surfaces, mapping, systems of lines in *n*-dimensional space, Cremona transformations, multiple correspondences, surfaces and varieties Each chapter ends with a bibliography, the shortest of which mentions 79 papers, and the longest 239 The report is of great value to the working geometer

Spectroscopic Parallaxes of Stars An important catalogue of spectroscopic parallaxes has just been published by Prof W. S Adams and others of the Mount Wilson Observatory (*Astrophys J*, **81**, 187, 1935) The methods used are the same as those in previous work of this kind, namely, the comparison of the intensity of a line sensitive to absolute magnitude with a neighbouring line of fixed intensity, calibrating curves connecting the intensity difference with absolute magnitude being constructed from the known data of trigonometrically measured stars As some of the lines used are really blends, separate curves have to be drawn for groups of stars within narrow ranges of spectral type The only differences between the method of this latest list and that of earlier ones from Mount Wilson lie in the use of some additional pairs of lines, and in the application of minor corrections to the reduction curves on account of the large increase in the available number of trigonometrical parallaxes The new list contains the spectroscopic absolute magnitudes and parallaxes of 4,179 stars, mostly of types *F–M*, but with a few *A*-type stars, and includes most of the stars given in previous lists (completely re-measured) All Boss stars of these types north of declination −26° are included as well as many fainter stars from the selected areas or of special interest on account of proper motion This is the largest catalogue of stellar parallaxes hitherto published, and the Mount Wilson observers are to be congratulated on this result of their labours.

The Twin Polygraph and Strobograph

ULTRA-RAPID CINEMA-PHOTOMICROGRAPHY

By A. G. LOWNDES, Marlborough College, Wilts

THE process consists primarily of filming rapidly moving micro-organisms by means of intermittent light. The source of light is an open arc light and the intermittent character is obtained by rotating, at high speed, a suitable disc, pierced by one or several slots, between the arc and the microscope. The number of exposures per second obtained in this way is almost unlimited while the time of each exposure can be made very small. Thus if the disc is rotating at 100 rev. a second, and there are 12 slots in it, the number of exposures will be 1,200 a second. If each slot subtends an angle of 1°, the exposure will be $1/100 \times 1/360 = 1/36,000$ sec.

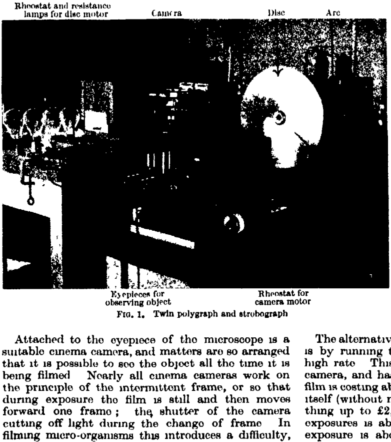
Rheostat and resistance lamps for disc motor
Camera
Disc
Arc
Eyepieces for observing object
Rheostat for camera motor

FIG. 1. Twin polygraph and strobograph

Attached to the eyepiece of the microscope is a suitable cinema camera, and matters are so arranged that it is possible to see the object all the time it is being filmed. Nearly all cinema cameras work on the principle of the intermittent frame, or so that during exposure the film is still and then moves forward one frame; the shutter of the camera cutting off light during the change of frame. In filming micro-organisms this introduces a difficulty, for if an organism gives a spasmodic leap, the critical point is as likely to occur during cut-off as during exposure. In order to overcome this, a microscope is used possessing a single objective but two eyepieces, while the camera is constructed so that a film works in conjunction with each eyepiece, cut-off in one occurring during exposure in the other. Thus so long as the camera is working, continuous exposure is assured.

The next important point is that the speed of the camera is not that of the high-speed disc; the two are worked quite independently by separate motors. The speed of the camera is much lower than that of the disc, so that each frame of film will receive several images (hence polygraph). If the object is still, the images will be superimposed and will coincide, while if the object moves they will be spread over the frame of film.

With certain objects (for example, a cilium or the long antennule of a copepod) it is advantageous to get several images on one frame, and the interpretation and measurement of the movement presents little difficulty, but in other cases it is unwise to get more than three images on one frame.

The process was originally invented for the investigation of limb movement of minute Crustacea, or ciliary movement, etc., and was not intended for projecting purposes, but in certain cases these *polygraph* films were highly successful when projected. Two such films showing the movement of the ostracod sperms under the highest powers of the microscope were shown in Section D (Zoology) at the Aberdeen meeting of the British Association. For projecting purposes better films are obtained by the *strobographic* process, but such films are only obtainable if the object shows metachronal or rhythmic movements. In this case the high-speed disc carries one slot only and the speed is tuned-in to the object, giving the ordinary stroboscopic effect. The camera is then tuned-in to the disc so that a single frame receives a single image.

The advantages of the method are (1) the great saving in cost of film; (2) the comparatively low cost of the apparatus (camera, microscope, motors, arc-light and resistances, etc., £350); (3) the large number of exposures per second; (4) the ultra rapid exposures.

The alternative method of obtaining rapid exposures is by running the film through a camera at a very high rate. This is the principle of the slow-motion camera, and has the disadvantage that when in use film is costing about 3s. 9d. a second, while the camera itself (without microscope or lighting) may cost anything up to £2,000 or even more. The number of exposures is about 250 a second while the time of exposure is about 1/3,000 sec. Slow-motion films are, however, eminently suitable for projecting purposes. Another disadvantage is that the camera only attains full speed after an interval of 1–2 sec., and about 24 ft. of film is wasted every time the camera is stopped.

In the polygraphic and strobographic processes speed and exposure depend on the disc only, and this can run continuously without using film. So far, a speed of 24 frames a second has proved ample, and with a twin film the cost is 6d. a second, or 3d. with a single film. The speed of the disc can be varied and the slots are adjustable, so that the time of exposure, the interval between exposures, and the number of exposures a second can all be adjusted to suit the object. The camera can be driven at speeds varying from 20 to 120 frames a second, while a single or twin film can be used At these low rates the camera can be started or stopped practically instantaneously without loss of film, and one can expose either 1 ft or 100 ft

The apparatus is somewhat cumbersome, since the arc and high-speed disc must be on separate stands or tables from the camera and microscope, while in high power work the camera itself with its motor must be insulated from the microscope, otherwise vibration will cause difficulties

International Congress for Scientific Management

THE International Congress for Scientific Management to be held in London on July 15 and subsequent dates is the sixth of a series which have been held in various European capitals since 1924 The hosts of the Conference are a Council—nominated by a number of societies interested in one phase or other of the management movement, and the technical societies—which has appointed an executive committee composed of outstanding industrial leaders and others with Sir George Beharrell as chairman The patron is H R H The Prince of Wales The organisation is in the hands of committees having as chairmen, Dr E F Armstrong, Sir Henry Fowler, Mr G R. Freeman, Sir George Courthope, Prof Winifred Cullis The genesis of the invitation is the desire both to entertain the delegates in England, to show that Britain has a factory and business organisation fully up to the most modern practice, and to arouse public interest in general in the subject of scientific management

The work of the Congress is divided into six sections each of which will hold four technical sessions The sections will deal with development, distribution, educational and training, manufacturing, agricultural and domestic management respectively At each session, papers falling under a specific heading will be discussed The papers, of which there are two hundred, in six distinct volumes, are already in type and have been circulated to members ; each paper has a summary in three languages The papers for each session have been summarised by an expert *rapporteur*, which summary alone will be read, leaving the session available for discussions which are to be the main feature of the meeting Presidents of eminence—in all twenty-four—have been obtained for each session

The Conference will be opened at noon on July 15 by H R H The Prince of Wales, who is taking a keen interest in it and is expected to speak at some length on particular phases of the subject

The subject chosen for the first plenary session is the topical one of management problems arising from Government intervention, which is expected to give rise to an illuminating discussion

The second plenary session will be devoted to consideration of the simplification of data, the place of statistics and the standardisation of terms

A large number of visits has been arranged to factories and to places of interest for members of the agricultural and domestic science sections

At the end of the Congress, tours have been arranged in special trains with sleeping cars to enable the overseas visitors to combine the inspection of some of our most famed scenery with visits to some highly organised factories, chosen so as each to illustrate a different phase of the management problem The social side of the Congress has not been neglected and every opportunity will be given for members to fraternise

Many of the papers are of outstanding interest and make important contributions to the development of management regarded as an exact science ; the authors of the British papers were invited to contribute them by the organising committee as representing the best experience in the particular phases The information accumulated in the volumes is such that no industrial library can afford to be without them

It is anticipated that the Congress will have a large, if not a record, membership, but its arrangements have been made as far as possible sufficiently elastic to allow for expansion There are few in business or wishing to attain managerial rank who are unlikely to profit by attending its deliberations moreover, every support is deserved by the organisers, who are working on a purely voluntary basis with the sole object of giving testimony to the up-to-date state of British business organisation in every phase of activity

Intending members should apply immediately to Mr Harry Ward at 21 Tothill Street, Westminster, S.W 1, so that they may receive the Congress papers in ample time to give them the necessary study

Fuel Research in Great Britain

THE Fuel Research Station at East Greenwich was open for inspection on June 4, and about 250 guests were received by Sir Harold Hartley, chairman of the Fuel Research Board, and Dr. F S. Sinnatt, Director of Fuel Research. The whole of the plant was on view, and the work in progress was explained and demonstrated.

Particular interest was taken in the new semi commercial scale plant for the hydrogenation cracking of tar to motor spirit. This plant commenced working on March 1, and was on view for the first time. It is designed to deal with 300 gallons of tar or creosote a day. One passage through the plant converts about half the tar to motor spirit, and by recirculating the residue the whole of the tar can be converted, yielding an equal volume of spirit Demonstrations were given of a new plant for the dry cleaning of coal, while a washery table was preparing 'ultra clean' coal containing less than 1½ per cent of ash, from a commercial coal containing about 5 per cent. The coal survey that is being carried on throughout the coal fields of Great Britain has shown that large quantities of 'ultra clean' coal of various types can readily be prepared if required for special purposes

The pulverised fuel burners designed at the Fuel Research Station, and now in commercial use, were shown working in both Lancashire and water tube boilers. A method of dividing a stream of air borne coal into two equal streams was illustrated; owing to the unequal distribution of the coal over the cross-section of the pipe when pulverised coal is carried in a stream of air, this equal division has presented difficulties. An ingenious device for estimating the rate of settlement of a suspension of a solid in a viscous liquid was on view. The tube containing the suspension forms part of a pendulum, the change of the period of swing of which is a measure of the rate at which the centre of gravity of the system moves downwards. This apparatus was designed for investigations into the stability of suspensions of coal in oil, but may have other applications.

The experiments in the full-scale horizontal gas retorts, showing the advantages of introducing steam during the last portion of the carbonising period, were of special interest to gas engineers.

Fauna of Indian Salt Lakes

LIEUT.-COL. R. B. SEYMOUR SEWELL has made an interesting study of the fauna of the salt lakes of Calcutta (*Rec. Ind. Mus.*, 36, Part 1, 1934). Recent changes in the general character of some of the rivers in Lower Bengal have had a profound effect on these salt lakes and their associated streams, indirectly influencing the general character of the fauna of certain areas, silting in the rivers and canals due to various causes being the main factor in these changes.

The chief zoological interest in this brackish water area lies in the fact that it forms one of the main highways by which marine organisms gradually establish themselves in fresh-water. In the neighbourhood of the large river estuaries there is a very great amount of available food, both organic and inorganic, and there is a considerable lowering of the salinity in the surface water. The coastal species must be able to withstand a wide variation of salinity, and a further step from brackish- to fresh-water would not be difficult.

The region was almost certainly part of the Bay of Bengal, and with a gradual extension of the delta seawards the water of the rivers and lakes became less salt, but extremely slowly. Both marine forms from the coastal waters and fresh-water species from the rivers would be carried into the salt lakes. There seem to be few instances of a definite attempt at migration upstream from the sea to the fresh-water areas above the influence of the tide.

Although other groups are mentioned and to a certain extent listed, the copepods are studied in the greatest detail. There are true fresh-water forms in the Hooghly River, and in the salt lake with the pools and canals there are normal brackish-water forms; associated with the latter we may get definitely marine forms, a gradual change from fresh-water to salt-water species showing in the plankton from the fresh-water of the river system towards the sea.

With regard to the widely distributed *Pseudodiaptomus*, it is a question whether migration has been from the sea into fresh-water or from fresh-water to the sea, or from brackish-water into both regions. The author is of the opinion that it is of marine origin, and that there has been, and still is, a tendency towards migration into brackish- and on into fresh-water.

University and Educational Intelligence

CAMBRIDGE.—Mr. G. H. A. Wilson, Master of Clare College and formerly M.P. for the University, has been elected Vice-Chancellor for the academical year 1935–36.

Dr. W. H. Thorpe, of Jesus College, has been re-appointed University lecturer in entomology. Dr. D. H. Barron has been appointed University demonstrator in anatomy.

Miss Dorothy Hill, of Newnham College, has been awarded a Senior Studentship by the Royal Commissioners for the Exhibition of 1851.

OXFORD.—Dr. N. V. Sidgwick has been granted the title of professor during the tenure of his readership in chemistry.

Dr. A. H. Gardiner, vice-president of the Egypt Exploration Society and research professor of Egyptology in the University of Chicago, has been elected honorary fellow of the Queen's College.

IN order to encourage research on eugenic problems, and on the genetical and statistical methods needed, if they are to be profitably attacked, the Eugenics Society has decided to provide the funds for a research studentship of £250 a year, tenable at any of a number of suitable research departments in the United Kingdom. The studentships will bear the name of Leonard Darwin, honorary president of the Society. To make the awards and administer the studentships, an independent committee has been set up with the co-operation of the Royal Society, the Royal Society of Edinburgh, and the Royal Statistical Society. The studentships will be renewable for a second year.

THE Social Studies final report of the American Historical Association (Scribner, 1934, pp. 168, 1.25 dollars) has become one of the chief subjects of educational discussion in America. Dealing as it does with some of the most vital issues of contemporary social life in that country and being, according to one critic, a "daringly realistic" indictment of the present social order, it has, naturally, come in for a good deal of abuse. In *School and Society* of March 30 appears an address by Prof. Jesse H. Newlon to the American Educational Research Association, in which some of the attacks on it are answered. Among these are complaints of paying lip-service to democratic ideals while knifing them in the back by enlarging on trends towards collectivism, of countenancing the indoctrination of students with subversive ideas, of decrying objective tests and the scientific method generally, of needlessly disparaging existing methods of instruction in teacher-training institutions as mechanical and sterile, of irrelevant criticism of systems of control and administration of schools. The answers throw much interesting light on current educational practices. Prof. Newlon holds that the scientific method has become a sort of fetish—educational research being concentrated on it as a chief objective in the delusive belief that it can not merely illuminate, but also provide qualitative solutions of problems of educational policy. Summing up the significance of the report, it dares, he says, to make a social analysis and, in harmony therewith, to recommend policies for making education a more effective instrument for social reconstruction.

Science News a Century Ago

Cholera Statistics for 1831-32

On June 15, 1835, Sir David Barry read a paper to the Statistical Society "On the Statistics of Epidemic Cholera as it occurred in Great Britain between the 26th of October 1831 and 31st of December 1832". Sir David divided his paper into two main parts dealing respectively with the progress of cholera in Great Britain and in the Metropolis. The disease, he said, prevailed as an epidemic in London during the ten months February 9 until December 31, the whole number of new cases being 11,020 and of deaths 5,275. The total numbers of new cases and deaths, for Great Britain and the Metropolis, were 80,203 and 30,924 respectively. In concluding his paper, he made observations on the quarantine regulations, in the course of which he said that *the history of cholera by no means justified* the apprehension which re-enacted the old expensive plague-precaution system of delaying the landing or sale of cargoes, until the promulgation of a paper by the Central Board of Health in January 1832 entitled "Reasons founded on Authentic Facts in the History of Spasmodic Cholera, for establishing a Specific Code of Sanitary Restrictions for that Disease, considered independently of Plague, Yellow Fever, and other Infectious Maladies" put a period to the evil. England having thus taken the initiative in the amendment of the quarantine laws, considerable mitigation very soon followed in other countries, with great relief to trade and without compromising the security of the public health.

Sir David Barry (1780–1835) had been employed by the Government to investigate the yellow fever epidemic at Gibraltar in 1828; and, on the outbreak of the cholera epidemic, was sent to Russia to report on it.

Metamorphoses in the Crustacea

Among several papers submitted to the Royal Society on June 18, 1835, was one "On the Supposed Existence of Metamorphoses in the Crustacea" by J. O. Westwood, secretary to the Entomological Society. A report of this paper in the *Philosophical Magazine* said: "The author refers the principal modifications of form which occur during the progressive development of animals to the three following heads: 1st, that of an animal produced from the egg in the form which it is destined to retain through life, its only change consisting of a series of moultings of the outer envelope, attended merely by an increase in size, and not by the acquisition of new organs; 2ndly, when the animal at its exclusion from the egg, exhibits the form which it continues to possess, subject to a series of moultings, during several of the last of which certain new organs are gradually developed; and 3rdly, when the form of the animal at its exclusion from the egg, is totally different from that under which it appears at the later periods of its existence, such change of form taking place during two or three of its general moultings, and consisting, not only in the variation of the body, but also a complete change in the nutritive and digestive systems and in the acquisition of various new organs. This last phenomenon peculiarly characterizes what is termed a metamorphosis . . ."

Balloon Excursion Extraordinary

Under the above title, the *Mechanics' Magazine* of June 20, 1835, quoted the following extract from the *New York Journal of Commerce* relating to a balloon flight a short time before: "Mr. Clayton, a volunteer aeronaut in the West, made an ascent from Cincinatti, and was observed to pass off in a south-easterly direction. Nothing more was seen of him for a number of days and great anxiety was felt for his safety. At length, nine days after his departure, he returned to Cincinatti, having made the most extraordinary excursion on record. He did not, indeed, ascend as high as a number have done before him, but the distance he sailed is beyond all precedent, being not less than 350 miles. All this was accomplished in 9½ hours, which is at the rate of nearly 37 miles an hour. The greatest height to which he ascended was about 2½ miles." Commenting on this, the *Mechanics' Magazine* said: "The longest aerial voyage previously on record was, we believe, that of M. Garnerin in 1807, who travelled 300 miles in 7½ hours."

Societies and Academies

DUBLIN

Royal Dublin Society, April 30. J. H. ORTON: The biological condition of re-laid oysters. Exceptionally high mortality had occurred amongst these oysters, but no disease was recognised, and their poor physiological condition and the presence of 'chambering' in the shells made it probable that the mortality was due to abnormal weather conditions. G. T. PYNE: A simple titrametric method for the approximate determination of milk phosphates. This method is suitable for the estimation of soluble and of total phosphates. J. BAYLEY BUTLER, J. CARROLL and MISS KIRBY: The toxicity of native pyrethrum. Experiments show that pyrethrum prepared from Irish-grown plants approximates in toxicity to that obtained from plants grown in England, and exceeds that from most other sources.

Royal Irish Academy, May 13. K. G. EMELÉUS: The Faraday dark space. New evidence is brought forward to show (*a*) that resonance radiation emitted from the negative glow and travelling in straight lines is of importance in fixing the length of the Faraday dark space; (*b*) that there is a secondary electron emission from surfaces in the Faraday dark space. JAMES SMALL and ISOBEL K. JOHNSTON: Mathematical evolution in Compositæ, including proof of normal death of species. Udny Yule's mathematical theory of evolution is confirmed in detail, but modified by the old-age death of species, not according to chance, after a limited lifetime. The ages of the tribes of Compositæ, calculated from Yule's formulæ, in doubling periods, when plotted against a time scale in million years, follow an exponential curve, the BAT curve, with the formula $k + nd = T\,2^n$. For Compositæ, grasses and Angiosperms in general, $k = 0{\cdot}6$, $d = 0{\cdot}9$, $T = 1{\cdot}09375$ million years. The BAT curve is based upon observed points for Compositæ, but it applies to Mrs. Reid's percentage extinctions for the Pliocene deposits and to Lyell's shell curve which goes back to Palæocene, with for molluscs an 11 million-year doubling period and a 66 million-year lifetime for species. It applies also with simplicity to the evolutionary history of species-number in Angiosperms back to Jurassic, and of the grasses back to the Upper Cretaceous. The principles have been checked by Yule on snakes and lizards, and two groups of insects, so that the mathematical forms are generally applicable to both plants and animals

Edinburgh

Royal Society, May 13 J A. Kitching . Ecology of intertidal rock surfaces on the coast of Argyll. The general and detailed distribution of various of the commoner animals and seaweeds on the coast of Argyll are described, with special reference to the effects of wave action, angle of slope of rock surface, mutual interrelations, and other factors. Various Fucoids are limited by mechanical shock of the waves Certain barnacles require wave action, but are restricted by the rubbing of algal fronds Various organisms which on wave-beaten coasts are confined to deeper water extend up to the low-tide mark in very sheltered localities Fucoid fronds protect certain organisms from desiccation, and overhanging rocks act similarly L J Wills Rare and new ostracoderm fishes from the Downtonian of Shropshire These include one specimen provisionally referred to *Ctenaspis*, Kiaer, new to Britain , *Anglaspis macculloughi*, A S Woodward, a rare form, but in this instance abundant and in perfect preservation, which displays many details of the boney structure and impressions of the gill-pouches and brain-case , *Tesseraspis tessellata*, gen et sp. nov , a large form with polygonal tuberculated plates fused into a shield ; *Phialaspis*, gen nov , *symondsi*, Lank , a large shield with smooth central area and tuberculated border The last two are probably Drepanaspids Ian Sandeman Mathematical representation of the energy levels of the secondary spectrum of hydrogen (3) Using the observational data of C. R Jeppeson, the molecular constants of the ground state of H_2 are calculated on the basis of J L Dunham's theoretical work A somewhat similar analysis is carried out for the ground state of H_2^+ Energy values are calculated by the method of G Jaffé, and a simple mathematical formula is found to fit these values in the neighbourhood of the position of equilibrium The molecular constants of the two states are compared

Paris

Academy of Sciences, April 29 (*C R* , **200**, 1501–1552). Emile Cotton · Certain singular integrals Jean Cabannes and Jean Dufay . The Vegard-Kaplan bands in the spectrum of the night sky Discussion of the results of observations made between 1933 and 1935 at the Pic du Midi, Montpellier, Saint-Genis-Laval and Forcalquier Lucien Daniel : Achenes of deficient appearance in the dandelion. Georges Bouligand The conditions of variance of propositions Carlos E Dieulefait · Correlation *au sens des modes* J Geronimus. Some inequalities for polynomials the first coefficients of which are given V. Avakumović : An extension of the condition of convergence of inverse theorems of summability. Szolem Mandelbrojt : A problem of Carleman concerning analytical functions Simon Stoïlow : Remarks on the definition of the nearly analytical functions of Lavrentieff. Amédée Guillet : A viscosimeter formed by a sphere in rotation in a fluid. Louis Leprince-Ringuet : The sudden changes of velocity and direction shown by the trajectories of electrons of great energy. Radu Titeica : The absorption spectra of the alkaline bichromates. André Charriou and Mlle. Suzanne Valette · The influence of water on the sensibility of photographic emulsions Rapid emulsions become less sensitive after absorbing water. The experiments show the necessity of protecting photographic apparatus used in aerial photography against large temperature variations. Horia Hulubei The use of X-rays for showing the deformation of a crystalline network under the action of an electric field Proof of the variation of the reticular constants of quartz and mica under the action of a static electric field Victor Henri and C H Cartwright · The absorption spectrum of benzene at a high temperature Louis Bouchet The properties of a zinc of exceptional purity compared with those of other specimens of zinc The pure specimen was obtained by fractional distillation in a vacuum and contained less than 0 0001 per cent of impurities The extra pure zinc is more resistant to hydrochloric and sulphuric acids than ordinary zincs, but is more rapidly attacked by nitric acid Maurice Chaix · The ultra-violet absorption spectra of some arylthionium salts Henri Triché · An arrangement for quantitative spectrum analysis Charles Courtot and Tsé-Yei-Tung Critical study of the action of thionyl chloride on phenol M Burgaud · Some recent magnetic observations made in the south and south-west of China Pierre Laumont and Marc Simonet The genetic and cytological study of the tendroid forms which appear in the descendants of the intergeneric hybrid *Ægilops triuncialis* × *Triticum durum* Michel A Machebœuf, Mmes Georgette Lévy and Marguerite Faure . Researches on the chemical nature of the lipoid haptene fixing agent of tubercle bacilli killed by heat Alexandre Besredka and Ludwik Gross The local immunisation of the skin against the sarcoma of mice

Amsterdam

Royal Academy of Sciences (*Proc.*, **38**, No 4, March 30, 1935) H J. Jordan Tonic contraction and tonic retention of the contraction in the muscles of *Aplysia limacina* under the influence of alternating temperatures. M W Woerdeman . Experimental analysis of some phenomena of fertilisation and cleavage. Experiments on the artificially inseminated eggs of *Paracentrotus lividus* and *Echinus miliaris* W. H Keesom and K W Taconis An X-ray goniometer for the investigation of the crystal structures of solidified gases Apparatus for the production and examination of the crystals of solidified gases at low temperatures Data for ethylene. W H Keesom and J. Haantjes : The vapour pressure of neon at liquid hydrogen temperatures. Vapour pressures between 15° and 20·4° K. and their representation by the theoretical formula E. Cohen, W. A. T Cohen-de Meester and A. K W. A. van Lieshout : The influence of mechanical deformation on the velocity of transformation of polymorphous metals. Rolling, drawing or bending of white tin wires enormously increases the velocity of transformation into grey tin. J H C Merckel : Surface tension of homologous series Properties such as surface tension and adsorption show a linear or quadratic dependence on the length of the carbon chain A. Herrmann : Linear differential systems and matrix equations. C. Visser : The angular derivative of univalent functions. C. Visser Boundary correlation in conformal transformation H. Freudenthal : The R_n-adic development of spaces and groups. H. G. BUNGENBERG DE JONG and P V D LINDE · Coacervate sols and their relation to the theory of lyophilic colloidal stability In a narrow range of concentration of added alcohol, glycogen sols show marked opalescence The observed phenomena are explicable in terms of the small electrical charge and its non-uniform distribution on the sol particles H G BUNGENBERG DE JONG Oriented coacervates and their bearing upon the formation of colloid-crystals The coacervates from sols of *Amylum solubile* sometimes coalesce with the observance of preferred orientations. These oriented coacervates consist of thin hexagonal plates the properties of which were determined H J C TENDELOO. Researches on adsorption electrodes (2) Mineral electrodes Investigation of mica (muscovite) as an electrode in determining ion exchange A. H. W ATEN, JR Adsorption and ion exchange. Deduction of the Langmuir adsorption isotherm allowing for the interaction between ions J STUURMAN: Oxidation velocities of some unsaturated hydrocarbons with peracetic acid in acetic acid solution. A DE BUCK and N H SWELLENGREBEL The salivary glands in hibernating *Anopheles maculipennis* var. *messeæ* and semi-hibernating *Anopheles maculipennis* var *atroparvus*. The paper describes a means of identifying the two species in the presence of one another and shows that they behave differently, one taking blood and the other fasting in the same environment. H GERTH. The distribution and evolution of the larger Foraminifera in the tertiary sediments. Java, Western India, South-Western France and the West Indies are compared with regard to the appearance and evolution of the larger Foraminifera in the tertiary.

CAPE TOWN

Royal Society of South Africa, March 20. I. DONEN Studies in deciduous fruit (2) The effect of time and picking on chemical changes in store of the Kelsey and Gaviota plums W. E. ISAAC The organic matter content and carbon-nitrogen ratio of South African soils of the winter rainfall area The C/N ratios of the soils studied range from 11·2 · 1 to 22·9 : 1, with an average for the twelve soils of 16·6 : 1, and evidence is presented for regarding the C/N ratio of the winter rainfall region soils of the South West Cape as being of the order of 15 . 1 Within a rainfall locality, the C/N ratio widens with increasing organic matter content. In passing from soil to subsoil, with one exception (Krom River farm), there is a marked decrease of organic carbon and nitrogen and thus of organic matter, and this is accompanied by a narrowing of the C/N ratio C VON BONDE: Reproduction, embryology and metamorphosis of the Cape crawfish, *Jasus lalandii*. The embryology is worked out in detail for the first time and all the stages from the time of the extrusion of the eggs and their attachment to the pleopods of the female's abdomen worked out. The nauplius stage, which is here passed in the egg, appears 35 days after the eggs are laid A new stage in the larval development, the 'prenaupliosoma', is described, as this stage was actually observed immediately the eggshells burst. The various stages in the subsequent metamorphosis are described, the experiments having been conducted in a specially constructed hatching box. An attempt is made to determine the rate of growth of the crawfish from the time the first true crawfish form was observed up to the time of sexual maturity.

GENEVA

Society of Physics and Natural History, March 21. E. HELD and MLLE K PONS. A pure auxogen action obtained by heating the urine of a pregnant woman MLLE. A. MOSZKOWSKA A luteinising principle of the posterior lobe of the hypophysis The author has proved that alkaline extracts of the posterior lobes of the hypophysis of the ox exert a special luteinising action on the ovaries of guinea pigs It affects the granular tissue exclusively, thus differentiating it from the endocrine actions of extracts of the prehypophysis. E. GUYENOT and J MEIERHANS: The swim bladder and pneumatic canal in the Cyprinidæ The author has undertaken the study of the function of the pneumatic canal of the air bladder of the phytostome fishes This canal forms the normal method for rejecting the excess gas in the bladder when the external pressure is gradually lowered DON ZIMMET and E. FROMMEL The action of a nucleosidic preparation (lacarnol) on the nervous excitability and conductivity. DON ZIMMET, B. GHINSBERG and L JANCU · The influence of a hormonoid preparation (padutine) on the development of the egg of *Rana temporaria*

LENINGRAD

Academy of Sciences (*C R*, 1, Nos 7–8, 1935) L. PONTRJAGIN The Betti numbers of compact Lie groups G APPELROT Contribution to the problem of real continuous solutions of differential equations of the simplified fundamental form A POPOV: Certain definite integrals A MARKOV Quenching method as applied to the photometry of astronomical objects which are just visible V NUMEROV General formulæ for the development of perturbing forces in the calculation of absolute perturbations in polar co-ordinates N SHISHAKOV (1) Structure of the surface of oxidised iron (2) Powder method in electronography D. IWANENKO Electrodynamics and the Dirac theory of holes N DOBROTIN, I FRANK and P. CHERENKOV Observations of cosmic rays with the Wilson camera on the Elbrus L TUMERMAN Dependence of the fluorescence spectra of solutions on the viscosity of the solvent V. LEVSHIN: Connexion between the spectra of absorption and of luminescence in weak solutions of dyestuffs A TERENIN. Internal recombination during photodissociation of polyatomic molecules K. ABLEZOVA and S. ROGINSKIJ (1) A new type of promotor (2) Hydration by the adsorbed atoms of hydrogen W SHULEJKIN · Active films on the surface of the sea I. KNUNJANZ Condensation of aliphatic oxides with α-aminopyridene. B MOLDAVSKIJ and S LIVSHITS. Isomerism of carbohydrates (1) Chlorination of isomers of hexane and octane by means of antimonium pentachloride as a method for their quantitative determination J. SYRKIN and V VASILJEV Velocity of reaction and the quantity of catalyser M. USANOVICH: Anomalous electrical conductivity K. SUKHORUKOV, E KLING and D KLJACHKO Formation and distribution of bios. N PROKOPENKO · Finds of rock-forming orthites in the rocks of Central Asia I. ZASLAVSKIJ. Contraction and chemical structure of the terrestrial globe V BARANOV and S KRECHMER · Application of photographic plates with a thick emulsion layer to the study of the distribution of radioactive elements in natural objects. S KRAEVOJ Experimental production of mutations in *Pisum* (1) Lasting chromosome modification produced by X-rays. (2) Permanent semi-sterility caused by X-rays. DONTCHO

Kostoff · Conjugation between morphologically different chromosomes in *Nicotiana* species hybrids M **Gavrilova**. Reversibility of the vernalisation process. L **Sergeev** Salt resistance of wheats and its dependence on variety S **Soldatenkov** Artificial ripening of subtropical fruit by means of alcohol and ethylene J **Sharov** Problem of regeneration of the epidermis in planarians A **Svetovidov** and G **Eremejev** The European and the Amur bitterling (*Rhodeus sericeus*) A. **Lisovskij** Orthitic granites from Karamazar

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, June 16

British Museum (Natural History), at 3 and 4 30 Capt Guy Dollman "British Mammals" *

Monday, June 17

Royal Geographical Society, at 8 30 —J M Wordie "An Expedition to the Canadian Pacific"

Tuesday, June 18

Royal Anthropological Institute, at 8 30 -(at the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1) —Dr H K Fry "Native Life in Central Australia" (Film)

Thursday, June 20

Royal Society, at 4 30 —Prof Otto Loewi "Problems connected with the Principle of Humoral Transmissions of Nervous Impulses" (Ferrier Lecture)

St Mary's Hospital, London, at 5 —Dr Joseph Needham "Problems of Chemical Embryology" *

Official Publications Received

Great Britain and Ireland

The National Physical Laboratory Report for the Year 1934 Pp iv+260+16 plates (London H M Stationery Office) 13*s* net

Development Commission Twenty fourth Report of the Development Commissioners being for the Year ended the 31st March 1934 Pp 122 (London H M Stationery Office) 2*s* net

Amgueddfa Genedlaethol Cymru (National Museum of Wales) Some Aspects of Forestry in Wales a Handbook to a Temporary Exhibition based on the Tree Collections in the Department of Botany, May 1–September 28, 1935 By H A Hyde Pp 22 (Cardiff National Museum of Wales) 3*d*

The Kent Incorporated Society for Promoting Experiments in Horticulture Annual Report (Twenty second Year) 1934 East Malling Research Station, Kent, 1st January 1934 to 31st December 1934 Pp 264+22 plates Free to Associate Members, 4*s* to non Members Misc Publication H 23 Supplementary Annual Report (Twenty-second Year) General Development and Activities, East Malling Research Station, Kent, 1st January 1934 to 31st December 1934 Pp 22 (East Malling East Malling Research Station)

The Carnegie United Kingdom Trust Twenty-first Annual Report, January–December 1934, approved by the Trustees at their General Meeting held on Friday, March 8th, 1935 Pp vi+88+6 plates (Dunfermline Carnegie United Kingdom Trust)

The National Council for Civil Liberties Annual Report and Balance Sheet 1934 Pp 36 (London National Council for Civil Liberties.)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1573 (T 3407 a, b, and c) · On the Calculation of Stresses in Braced Frameworks 5: The General Solution for a Cylindrical Tube of Regular Polygonal Cross Section By R V Southwell and J B B Owen. Pp 85+2 plates. (London H M Stationery Office) 4*s* net

The Lister Institute of Preventive Medicine Report of the Governing Body, 1935 Pp 35 (London Lister Institute)

Hull Museum Publications No 182 Excavations at the Roman Fort at Brough-on-Humber By Philip Corder Pp 38 1*s* No 183 What to see in the Hull Museums By Thomas Sheppard Pp 16 1*d* No 184 Record of Additions By Thomas Sheppard Pp 36 (Hull Hull Museum)

Report by the Hydrographer of the Navy on the Surveys carried out by H.M Naval Surveying Service and on the Work of the Hydrographic Department for the Year 1934 Pp viii (London Admiralty)

Ninth Report of the Commissioners for the Exhibition of 1851 to the Rt Hon Sir John Gilmour Pp 43 (London Royal Commissioners for the Exhibition of 1851)

Technical Publications of the International Tin Research and Development Council Series A, No 17 Factors Influencing the Formation and Structure of Hot-dipped Tin Coatings By E J Daniels Pp 10 (London International Tin Research and Development Council) Free

Other Countries

U S Department of Commerce National Bureau of Standards Circular of the National Bureau of Standards, C 406 Standard Time throughout the World Pp 24 (Washington, D C Government Printing Office) 5 cents

Smithsonian Institution Explorations and Field-Work of the Smithsonian Institution in 1934 (Publication 3300) Pp iv+88 Smithsonian Miscellaneous Collections Vol 93, No 9 New Species of Tertiary Cheilostome Bryozoa from Victoria, Australia By Ferdinand Canu and Ray S Bassler (Publication 3302) Pp 54+9 plates (Washington, D C Smithsonian Institution)

Brooklyn Botanic Garden Record Vol 24, No 3 Books and Manuscripts illustrating the History of Botany Pp 159 194 (Brooklyn, N Y Brooklyn Botanic Garden)

Egyptian Government Ministry of Public Works Annual Report for the Year 1928–1929 Part 1 Pp ii+59+26 plates (Cairo Government Press) 30 P T

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 144 The Rust of Cowpea Part 1 The Disease By Dr Tewfik Fahmy Pp iii+10+9 plates (Cairo Government Press) 5 P T

Publications of the Dominion Observatory, Ottawa Vol 12 Bibliography of Seismology No 4, October, November, December, 1934 By Ernest A Hodgson Pp 67–94 (Ottawa King's Printer) 25 cents

Tanganyika Territory Geological Survey Department Bulletin No 7 Outline of the Geology of the Musoma District, being a Preliminary Geological Survey of the Musoma Goldfields, with the exception of the Nigoti and Ikoma Areas By G M Stockley Pp ii+64+7 plates (Dar es Salaam Government Printer) 4*s*

Amani Memoirs A Synecological Study of the Usambara, Tanganyika Territory, with particular reference to Birds By R E Moreau Pp 43+2 plates (Amani East African Agricultural Research Station)

Det Kongelige Departement for Handel, Sjøfart, Industri, Håndverk og Fiskeri Norges Svalbard- og Ishavs-undersøkelser Meddelelse Nr 26 Some Echinoderms from Franz Josef Land, Victoriaøya and Hopen, collected on the Norwegian Scientific Expedition 1930. By James A Grieg Pp 10 Skrifter om Svalbard og Ishavet, Nr 54 Bibliographie des ouvrages norwégiens relatifs au Grœnland (Y compris les ouvrages islandais antérieurs à l'an 1814) Par Hroar Vartdal Pp 119 12 00 kr (Oslo Jacob Dybwad)

Bergens Museums Årbok, 1934 Heft 2, Naturvidenskapelig rekke, Nr 9–14 Pp 60+90+10+16+32+28 (Bergen A/s John Griegs Boktrykkeri)

Union of South Africa Report of the South African Museum for the Year ended 31st December 1934 Pp 17 (Pretoria Government Printer)

National Geographic Society Contributed Technical Papers Stratosphere Series, No 1 The National Geographic Society—U S Army Air Corps Stratosphere Flight of 1934 in the Balloon *Explorer* Pp 122 (Washington, D C National Geographic Society)

U S Department of the Interior Geological Survey Bulletin 851 The Book Cliffs Coal Field in Garfield and Mesa Counties, Colorado By Charles E Erdmann Pp vi+150+21 plates 35 cents Professional Paper 179 Origin of the Copper Deposits of the Ducktown Type in the Southern Appalachian Region By Clarence S Ross. Pp v+165+44 plates. 45 cents Professional Paper 185–B Paleozoic Formations of the Mosquito Range, Colorado By J Harlan Johnson (Shorter Contributions to General Geology, 1934–35) Pp ii+15–44+7 plates 10 cents (Washington, D C Government Printing Office)

U S Department of Agriculture Technical Bulletin No 471 Chemical Studies of Infertile Soils derived from Rocks high in Magnesium and generally high in Chromium and Nickel By W O Robinson, Glen Edgington and H G Byers Pp 29 (Washington, D C Government Printing Office) 5 cents

Mémoires de Musée Royal d'Histoire Naturelle de Belgique No 63 Beiträge zur Kenntnis Tertiärer Sirenen 1 Die Eozänen Sirenen des Mittelmeergebietes, 2 Die Sirenen des Belgischen Tertiärs Von Otto Sickenberg Pp 352+11 plates No 64 Die Plistozaenen Baeren Belgiens Teil 1 Die Baeren von Hastiere Von Prof Dr Kurt Ehrenberg Pp 126+13 plates No 65 Contribution à l'étude des Échinoïdes du Frasnien de la Belgique Par Eug Maillieux Pp 16+2 plates No 66 L'Aérolithe du Hainaut. Par Dr M Lecompte Pp 39+3 plates Hors Série Résultats scientifiques du Voyage aux Indes Orientales Néerlandaises de LL AA RR le Prince et la Princesse Léopold de Belgique Publiés par V Van Straelen Vol. 3, Fasc 15 Crustacea Brachyura By Isabella Gordon. Pp. 78 Vol 3, Fasc 16 Rhizocéphales (Supplément), par H Boschma, Stomatopod Larvæ, by M V Lebour Pp 17 (Bruxelles)

Catalogues

Oertling British Precision Balances and Weights. Pp 27 (London, L Oertling, Ltd)

Catalogue of recently purchased Botanical Books, including some interesting items from the Library of the late Miss Willmott, and many on Flowers and Flower Gardens, Floras, Gardening, etc (No 237) Pp 20 (London · Dulau and Co , Ltd)

Technical Brochure No 2 Shell-Wild-Barfield Quenching Oils Pp 20 (London G W B Electric Furnaces, Ltd.)

Apparatus for Radiology High Tension Transformer Units. (Publication No. A/35) Pp. 18 (London · Newton and Wright, Ltd)

Holiday Photography Pp 20. (London Burroughs Wellcome and Co)

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Control and Use of Poisons

THERE has recently been published the first report of the Poisons Board to the Home Secretary* The document contains the report proper, together with the Poisons List which the Board is required by the Pharmacy and Poisons Act to prepare, and a draft of Poisons Rules which the Board recommends shall be made by the Home Secretary. The provisional proposals of the Board were published in the autumn of 1934, and, doubtless as the result of representations since received, have been substantially modified in certain particulars in the present report The greater part of the Board's recommendations has to do with the control of the supply of poisons to the public, but owing to the present-day widespread use of some poisons in scientific and industrial work, the contents of the report are of interest to many others than those engaged in the preparation of medicines or the sale of poisons

The Board explains that, in preparing the Poisons List, it has so far as possible specified by name each individual substance included, and has endeavoured to avoid phrases such as "all poisonous alkaloids" which have the appearance of begging the question "What is a poison?" It has endeavoured also to avoid the use of group names, but the ingenuity of the organic chemist has compelled the adoption of an omnibus description such as 'derivatives' for some groups It is driven to the adoption of precise technical terms in the Poisons List, and the mystification of the layman at these "words of learned length and thundering sound" is to be provided for by the publication of a detailed, non-statutory, explanatory list.

In determining the inclusion of substances in the List, the Board has had regard to the following considerations:

"The danger of death or injury following

(1) the administration of a poison for criminal purposes,

(2) the swallowing of a poison in mistake for an innocuous substance,

(3) the inhalation through ignorance or by accident of the vapours given off by a poison,

(4) the incorrect compounding of medicines containing poison,

(5) the accidental taking in too large a dose of a medicine containing a poison."

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* Home Office Report of the Poisons Board in regard to the Poisons List and Draft Poisons Rules prepared in accordance with the Pharmacy and Poisons Act, 1933 (Cmd 4912) Pp iv+62. (London: H.M. Stationery Office, 1935) 1s net.

Suicide is largely ruled out as a risk which can be guarded against, presumably on the ground that, though you may prevent a would-be suicide from obtaining a poison, many other means remain available by which he can accomplish his intention Aspirin is discussed and rejected for inclusion in the List, the fatalities due to its use being insignificant when compared with the vast number of persons by whom it is used The possible legal difficulty caused by the presence of arsenic as an impurity in many forms of matter, and of cyanides and other poisons present in plants, is left by the Board to the good sense of those concerned, the gardener purchasing *Lobelia*, for example, being thereby freed from the necessity of buying his seedlings from a pharmacist and signing the Poisons Register into the bargain Special provision is made for the purchase of poisons by persons in charge of laboratories and generally by those requiring them for use in their trade, business or profession, so that there will be no interference with the normal business of the laboratory supplier

An interesting proposal about which there will be controversy is that for the supervision of the manufacture of pharmaceutical preparations containing poisons The proposal is that such operations shall be supervised by a pharmacist, a medical practitioner, a member of the Institute of Chemistry, or by a person who for three years has been engaged in such work The basis upon which these proposals are made is that members of each of the first three classes are subject to disciplinary control, a corrective to which the holders of university degrees are not amenable Nevertheless, a proposal which will in the future compel a graduate to subscribe to the Institute of Chemistry if he is to practise in a certain branch of industry is one which will scarcely commend itself to the universities or to the chemical profession as a whole, and it would appear that further consideration of this proposal will be necessary before the rules are actually made by the Home Secretary

Among substances included for the first time in the List are a number of antipyretics, of which acetanilide and amidopyrine are examples Acetanilide has largely gone out of fashion, even if it does not wholly merit the *ex cathedra* dictum of the late W. E Dixon that "it is a drug which ought never to be given under any circumstances". The addition of amidopyrine is presumably the outcome of recently published papers upon the effects of this substance in producing agranulocytosis in susceptible people, and time alone will show whether the Board has been stampeded by the chance publication of papers contemporaneously with its own work or whether it has in fact wisely anticipated a public danger There are in the List a number of substances which in their pure state may be regarded as museum specimens ouabain, brucine, curarine and thebaine are examples

Some recognition of modern developments in therapeutics and their potential dangers is seen in the inclusion of the active principles of the thyroid, pituitary and suprarenal glands Certain substances are to be restricted in their distribution to a medical prescription, among them the nitrophenols and nitrocresols, which had a short-lived vogue for slimming and, owing to their uncertain action in stimulating oxygen consumption, have led to fatalities In this class too are the derivatives of phenylcinchoninic acid, which have given rise to toxic jaundice of the liver, and the derivatives of barbituric acid, around which the "battle of the barbiturates" raged a year ago Thallium salts might reasonably have been added, although their uncertain action has presumably led to their general abandonment in medicine in recent years

A general survey of the report, the Poisons List and the Rules shows that the Board has performed its detailed and thankless task with great thoroughness and, it is to be hoped, with a fair measure of success It is satisfactory to note that the personnel of the Board is largely technical, comprising physicians, pharmacists, chemists, toxicologists and agriculturists How far representation could have been extended to include other interests and other experts is a debatable question There obviously comes a limit beyond which selection cannot go Nevertheless, the omission from the Board of one or more representatives of the large-scale industrial manufacturers of poisons is noteworthy, although there may well have been difficulties in the way of such an appointment, since selection among competing firms is not easy Up to a point, the absence of such representation is compensated for by the provision in the Act requiring consultation with industrial interests before the rules are made

It is to be hoped that this thorough revision of the poisons legislation of Great Britain will justify the pains that have been spent upon it The revision of the List is a piece of work which badly needed doing, and it has been done thoroughly But the rules bear the mark of the heavy hand of the lawyer The present "patchwork of provisions" has worked by the administering authorities accommodating themselves to the facts of the trade in poisons, while the Rules substitute for the discretion of the authorities a large number of detailed provisions In future, everybody concerned should at least be able to find his position set out in black and white, but there may well be some who, after a close reading of the rules, will echo the doubts of Mr Weller's charity boy on arriving at long last at the end of his alphabet

Reviews

Physics and Mechanics of the Metallic State

(1) *Handbuch der Metallphysik* Herausgegeben von Prof Dr G Masing Band 1 *Der metallische Zustand der Materie* Teil 1 *Gitteraufbau metallischer Systeme*, von Prof Dr U Dehlinger, *Grundlagen des metallischen Zustandes, Physikalische Eigenschaften der Metalle*, von Prof Dr G Borelius Pp xiii + 520 (Leipzig Akademische Verlagsgesellschaft m b H, 1935) 47 60 gold marks

(2) *Distortion of Metal Crystals* By C F Elam (Mrs G H Tipper) (Oxford Engineering Science Series) Pp xiii + 182 + 5 plates (Oxford Clarendon Press, London Oxford University Press, 1935) 15*s* net

THE investigation of metals by physical methods has undergone a remarkable development during the last fifteen years To this progress both physicists and metallurgists have contributed On one hand, metals and alloys can now be examined over a much larger range of temperature and pressure, and in much stronger magnetic fields than was previously the case The application of methods of X-ray analysis enables the lattice structure to be ascertained in which the positions of the atoms and the distances between them can be experimentally determined It is now possible, in the case of any solid alloy, to determine not only the number of phases at any given composition, but also the distribution of the atoms in those phases For this reason, the microscope and the X-ray spectrometer have become twin instruments for the characterisation of the structure of any metal or alloy During the period in question, theoretical physicists have been paying increased attention to the problems of the metallic state On the other hand, the new technique devised by metallurgists for the production of single crystals of metals by a variety of methods, has placed in the hands of physicists the most perfect form of any metal for investigation In addition, the progress of metallurgical research has rendered available a far larger number of metals in sufficient quantities for investigation than was previously the case Add to this the fact that the majority of metals are now available in a state of purity which exceeds 999 parts per thousand, and it will be seen that all the conditions are present for an intensive investigation of them by the best methods of physical research

Metals are now forthcoming in two different states—the polycrystalline and the monocrystalline The former represents what may be called their ordinary state in that it results by the usual methods of preparation The latter can only be obtained by some form of controlled crystallisation Some properties, such as specific heat, can be equally well determined in either state There is no difference in the value obtained Other properties, such as electrical resistance, which is the same in all directions in cubic crystals, but not the same in the case of non-cubic crystals, can in the former case be determined equally well on polycrystal specimens, apart from any special influence of crystal size In the case of non-cubic metals, however, such properties can only be completely investigated with single crystals, where the directional effects can be determined A polycrystal specimen in such a case would give a mean value if the directions of the axes are completely at haphazard In forged and drawn specimens, however, particular directions often predominate Finally, properties such as the intensity of magnetisation of a ferro-magnetic metal, which even in the case of cubic crystals depend on the direction, can only be determined on single crystals

The two books under review are examples of this modern work

(1) That edited by Masing is the first volume of a handbook of metal physics It is divided into two parts The first, contributed by Prof Dehlinger of Stuttgart, is devoted entirely to a study of the lattice structure of metals It is significant that almost all of them possess a high degree of crystal symmetry, and crystallise either in one form of the cubic or the hexagonal systems The only exceptions are gallium, indium, β-tin and γ-manganese which are tetragonal, and arsenic, antimony and bismuth which are trigonal The second part is the work of Prof Borelius of Stockholm, who sets forth a detailed survey and

examination of some of the principal physical properties of metals. Limits of space do not permit any detailed reference to either of these sections. It can only be added that both of them are of great value, and will prove indispensable to students of these subjects.

(2) The second volume under notice is the work of Dr. C. F. Elam. In the author's words, the scope of the book has been limited to "an account of the changes in structure accompanying plastic deformation, changes in physical and mechanical properties, and factors such as temperature influencing these changes". A short account of the effect of heat on deformed metal is also included. The author's aim has been to avoid unnecessary experimental details and to lay stress on methods, particularly those employed in investigations of the distortion of single crystals. This monograph is written with great ability and remarkable fairness, and clear distinctions have been drawn between the facts established by experiment, the inferences to be drawn from them, and the theory of the phenomena involved. It will be found very helpful by investigators in this field of research.

Both books are admirably printed and illustrated, but has not the time come when a protest should be made against the excessive 'loading' of the paper, which adds greatly to their weight? This is particularly the case with the German treatise. It is possible, though it is more difficult, to get satisfactory results with a lighter paper, and it would make the book in question much more convenient to use. H. C. H. C.

Diet and Health

Gesundheit durch richtige und einfache Ernahrung. Von Mikkel Hindhede. Gekurzte deutsche Ausgabe von Lothar Meyer. Pp. *x*+196. (Leipzig: Johann Ambrosius Barth, 1935.) 5.40 gold marks.

OUR adopted standards of diet consisting of 100 gm. protein, 100 gm. fat and 500 gm. carbohydrate with an energy value averaging 3,000 calories are derived from statistics of the food consumption of families in various cities. There is no difference of opinion about the caloric value, but the amount of protein has been much discussed and agreement has not been reached. In Great Britain the special committees of the Medical Research Council and the British Medical Association have adopted 50 gm. of animal or first-class protein as the minimum to be aimed at in compiling diets.

Many years ago, Dr. Mikkel Hindhede questioned whether so much protein was necessary, and whether it were better derived from animal or vegetable sources. He himself lived and brought up a family of children on a diet containing about 67 gm. total protein, mainly vegetable. The children were of equal stature to others and capable of great physical endurance. The cost of the diet (pre-War) was about 4*d*. a day. Country people in Europe likewise exist upon, and bring up healthy families with fine physique, on diets with even less protein. Hindhede thus came to doubt the accepted high protein standard. With the help of the vegetarian, F. Madsen, he started numerous experiments of long duration to ascertain the minimal amount of protein for maintenance. Madsen and also other subjects lived upon various low protein diets with perfect health. The most striking one was potato and fat in which the daily amount of protein was only 32 gm. This diet was also tried by the other subjects with success. It is pointed out that the healthiest and strongest men in Ireland live mainly on a potato and fat diet. Later, successful low protein experiments were made with diets consisting of coarse wholemeal bread, or whole barley, or whole oats with a little sugar and considerable amounts of vegetables and fruits, but substitution of white bread for the whole grain was a failure. The reason for the good value of the whole grain was due to the bran, which on trial was found to be easily digestible and to contain protein of high value similar to that of animal protein.

Though the amount of protein can be reduced to so low as 32 gm. a day, Hindhede does not advocate this minimum, but recommends 60–70 gm., mainly derived from whole meal wheat and potatoes, together with vegetables and fruits and occasionally some meat or fish. His simple and standard diet consists of 500 gm. coarse whole meal bread, 25 gm. butter, 100 gm. margarine, 500 gm. potato and 100 gm. whole barley meal. It yields 60 gm. of protein and costs about 6*d*. a day. Not one in a thousand, he says, would live upon this diet; everyone would wish to add to it, partly from superstition that it is inadequate and partly from its lack of palatability. Should it be supplemented by animal or vegetable foods, that is, meat, fish, milk or eggs, or by vegetables and fruits? He considers the second alternative is right, but has no objection to animal foods, except that they should be eaten in small quantities. The simple diet contains an abundance of all the vitamins and sufficient mineral salts. The addition of other foods will upset the balance. A list of foods is given. Only fat meat and fatty fish and eggs are classed as really bad. White flour and sugar and sweets and confectionery are intermediate. Whole grain, vegetables and fruits are the best foods. There is agreement, except in regards to fat meat, fish and eggs, with the results obtained from experiments on animals.

The diet drawn up by Hindhede from his own work and experience is similar to those eaten by certain native races in the Himalayas and in certain parts of China and the East. These peoples have the finest health and physique, and do not suffer from the intestinal diseases of the European or from cancer. There seems no question but that Hindhede is right. He refers to several institutions in which children have been healthily reared on diets of a similar nature. In Leysin the best results with tuberculous patients are with those on simple and cheap diets. There are people in Great Britain who live upon simple diets of this kind, but they are looked upon as cranks. Most people, as well as the medical profession, are imbued with the doctrine of high animal protein and scarcely dare to make any alteration.

This book should be translated into English and read without prejudice by the medical profession and the public. The simple diet is the healthiest and the cheapest. The cost of food could be reduced with advantage to health. There would be improved manual work and the possibility of competition with the workers in Eastern countries. The general lack of palatability of Hindhede's standard diet can be improved by proper cooking. Numerous recipes are given; they are well worth a trial.

R. H. A. PLIMMER.

Psychological Doctrine and Practice

(1) *An Introduction to Theory and Practice of Psychology.* By Dr. Ll. Wynn Jones. Pp. x + 308. (London: Macmillan and Co., Ltd., 1934.) 12s. 6d. net.

(2) *Duke University Psychological Monographs.* No. 3: *Conation and our Conscious Life: Prolegomena to a Doctrine of Urge Psychology.* By Prof. Helge Lundholm. Pp. 95. (Durham, N.C.: Duke University Press; London: Cambridge University Press, 1934.) 4s. 6d. net.

(1) IN this "Introduction", Dr. Wynn Jones deals with the subject-matter of psychology from the purely psychological point of view, that is, independently of philosophical speculation and physiological interpretation, and bases his exposition throughout upon the groundwork of Spearman's well-known principles. Though he by no means neglects the work of other schools of psychological thought, the author consistently and successfully applies these principles in all the chapters of the book, which deal in the main with problems of cognition.

Dr. Wynn Jones's plan is to give the reader, and especially the university and training college student, a straightforward working knowledge of the science, its methods of investigation, and the application of statistical treatment to its data. He accordingly introduces each topic by outlining an experiment which the student is expected to perform. (Although some of these experiments require the resources and technique of the laboratory, for the most part they need little or no apparatus, and can easily be carried out on the lines of the directions given.) The experimental data, thus presumably obtained by the student himself, but in any case already known, are next discussed at some length, and are illustrated by references to actual researches. Though Dr. Wynn Jones casts a wide net for his illustrations, it is of interest to note that many of these come from his laboratory at the University of Leeds and are borrowed from the theses of his own students. It is in these "Discussions" also that the views of other schools are elaborated, and comparisons are drawn between the different theoretical interpretations of the data that have been advanced and those which the author himself advocates. Questions upon the content of each chapter are then set for the student; and each chapter ends with a very useful bibliography. The plan is a good one, and calculated to lead the student to the desired objective.

As might be expected, Dr. Wynn Jones lays great stress upon the securing of reliable introspective and objective data in experimental conditions, and the treatment of such data by appropriate statistical procedures. Time and labour have been lost in the past by accumulating masses of data which, for lack of a statistical instrument, were not, or could not be, scientifically handled. In the same way much statistical calculation was worthless because of faulty or irrelevant data. Neither complaint can be made in respect of this 'Introduction'. Dr. Wynn Jones also emphasises the importance of the study of individual differences both for the practice and for the theory of psychology.

This volume is one of the now many evidences of the fecundity of the noegenetic principles and two-factor theory upon which it is based, and of the solidity of the foundations of exact introspection and mathematical analysis upon which they, in their turn, are grounded. The principles themselves are briefly, though clearly, stated towards the beginning, and the statistical methods at the end of the book. The intervening chapters cover a wide range of psychological topics, and should prove to be of great interest and value to the student.

(2) This monograph is a closely reasoned argument in favour of a view widely held by contemporary psychologists, and to an increasing extent by general biologists, that the behaviour of

animal organisms cannot be interpreted satisfactorily on the basis of 'mechanical' concepts such as tropisms and reflexes, but at all levels of evolution requires a teleological explanation. The reasoning is largely deductive from certain principles which Dr. Lundholm postulates, but is also supported by empirical observations. The assumption must be made that all animals experience inner urges towards goals the prosecution of which will satisfy their needs; and to this the further assumption must be added that conative experiences, the impulses themselves and their consequent activities, are directed by some kind of awareness, analogous to our own, which guides them to their goals.

The thesis is also developed that specialised (instinctive) behaviour forms become differentiated from a more primitive, generalised form, in which curiosity, together with the impulses of deference or defiance towards the environment, give rise to adaptive behaviour. In the first case the animal adjusts itself to its environment; in the second it modifies the environment so as to satisfy its biological needs. The combination of these impulses working together leads to belief in the reality of the particular kinds of psychological objects that constitute the 'world' of the animal in question, from the protozoa up to man; and it implies both insight and foresight. Curiosity, again, because of a law of the "affinity of cognitive dispositions", groups together similar psychological objects whenever a specialised impulse is activated, reinstating experiences of conative cycles set up by like impulses in the past. Language provides names for such objects—'dangerous', 'valuable', and the like. But when curiosity dominates its accompanying specialised impulse, there is no such selectivity; the mind reviews a general past in which event is related to event, and the objective relations between them are apprehended. This makes the conscious planning of means towards ends possible.

The monograph, which belongs to the literature of hormic psychology, shows traces of the influence of configurationism. It is both suggestive and stimulating.

Naturalists on African Lakes

Inland Waters of Africa: the Result of Two Expeditions to the Great Lakes of Kenya and Uganda, with Accounts of their Biology, Native Tribes and Development. By S. and E. B. Worthington. Pp. xix+259+40 plates. (London: Macmillan and Co., Ltd., 1933.) 15s. net.

DR. AND MRS. WORTHINGTON still found the place and occasion when the feel of a rifle was 'comfortable' during the night. They were also 'roasted' in places fit for no human life, ran constant and inevitable risk in their small boats on great lakes, and had marmalade for breakfast in one of the special hells they saw fit to visit. Such things make good reading, but cannot well be introduced into scientific papers, or official reports, and the authors have done a service in writing a general book, where the reader can find both enlightenment and entertainment.

A further and better justification is that travellers, and especially such travellers, inevitably make many important and suggestive observations in geography, anthropology and natural history, which are not perhaps sufficiently complete or novel for scientific papers, but, when put together in this way, provide a very good picture of African life. This will be of historical importance in only a few years' time, so rapid are the changes of the present age in Africa. The fathers of some of the Worthingtons' most skilful clerks or artificers may have been cannibals. What will the sons be?

Specialists and other students should look in this book for readable and, no doubt, very fair accounts of some interesting subjects. A survey of primitive craft, culminating in the Baganda canoe, suggests evolution rather than dispersion. The decay of communal emotion, in favour of individual emotion, is traceable in a comparison of dances, of which a very fine account is given, including the music. Canoe songs are not as well done as might have been expected, although it is good to have a record of the "Song of the Crowned Crane".

The changes in watersheds, with pluvial periods and earth movements, are well summarised in connexion with the distribution of species of fresh-water fishes, the last in itself a fascinating problem. Angling, food chains, farming the waters and artificial dispersion of species, are serious problems described. The account of the solution of the *Tilapia* problem in Lake Victoria reads: "Constant fishing every day throughout many years in the Kavirondo Gulf had reduced the stock of fish to such an extent that their breeding had been seriously affected", whereas the senior member of the Lake Victoria survey wrote, referring to the whole lake, "... this diminution of stock has not yet gone so far as to reduce the number of ngege that annually enter the fishery" (1929, p. 11).

The book is well printed, but would have been easier to read had the lines been further apart. Clear maps are in sufficient quantity and the photographs are interesting and beautiful, which means that serious difficulties of the tropics were surmounted. There is an index. M. G.

Short Notices

An Index to the Genera and Species of the Diatomaceae and their Synonyms, 1816–1932. Compiled by Frederick Wm. Mills. Part 1: *A–Ac.* Pp. 74. Part 2: *Ac–Am.* Pp. 75–148. Part 3: *Am–At.* Pp. 149–222. Part 4: *At–Bi.* Pp. 223–296. Part 5: *Bi–Ch.* Pp. 297–372. Part 6: *Ch–Co.* Pp. 373–448. Part 7: *Co–Cy.* Pp. 449–526. Part 8: *Cy–Di.* Pp. 527–606. Part 9: *Di–Eu.* Pp. 607–684. Part 10: *Eu–Ga.* Pp. 685–762. Part 11: *Ga–He.* Pp. 763–840. Part 12: *He–Me.* Pp. 841–920. Part 13: *Me–Na.* Pp. 921–1000. Part 14: *Na–Na.* Pp. 1001–1080. Part 15: *Na–Na.* Pp. 1081–1161. Part 16: *Na–Ni.* Pp. 1162–1240. Part 17: *Ni–Pl.* Pp. 1241–1320. Part 18: *Pl–Rh.* Pp. 1321–1400. Part 19: *Rh–St.* Pp. 1401–1480. Part 20: *St–Sy.* Pp. 1481–1570. Part 21: *Sy–Z, Appendices, Supplement.* Pp. 1571–1726. (London: Wheldon and Wesley, Ltd., 1933–1935.) 10*s.* each Part.

TWO groups of minute plants, the Desmids and the Diatoms, have long been subjects of study for those attracted by the elucidation of microscopic detail, and in both cases numerous species have been described and a complex synonymy has resulted. An index to the species and synonyms of Desmids was published by Nordstedt in 1896 and has been of great value to workers on the taxonomy of these forms. The fact that nothing altogether comparable has up to the present time been accomplished for Diatoms is no doubt to be ascribed to the wider range of literature to be traversed and to a more entangled synonymy. The labour involved was in fact much greater and Mr. Mills, whose index has been compiled over a long span of years, is to be congratulated on the successful achievement of so arduous a task.

Since a work of this kind has a permanent value rather beyond the average, one cannot but regret that it is not printed, for even at this early date an appreciable proportion of the pages of the typescript bear so feeble an imprint that it may well be doubted whether they will be readily decipherable fifty years hence. It is to be hoped that before then means will be found to secure a more permanent reproduction, for which the Royal Microscopical Society, to the fellows of which the work is dedicated, may perhaps be able to raise the requisite funds. The first part contains numerous typographical errors, a defect which is to be regretted since this part includes the principal bibliography. The final part contains a supplement with additional literature and a series of species omitted in the main body of the work.

F. E. F.

Ancient Ireland: a Study in the Lessons of Archaeology and History. By Prof. R. A. S. Macalister. Pp. xii+307+24 plates. (London: Methuen and Co., Ltd., 1935.) 10*s.* 6*d.* net.

IN introducing "Ancient Ireland" to his readers, Prof. Macalister explains that it is in effect a supplement to his "Antiquities of Ireland", which appeared in 1927. He now approaches the material with which he dealt in the earlier work from a more anthropological point of view. He has here essayed a reconstruction of the cultural history of Ireland from prehistoric down to historic times, including in his survey the renaissance of Celtic art in Christian times and the early churches and castles. For the detailed evidence, upon which this reconstruction is based, the reader is referred to the earlier volume. On certain topics, however, such as the origin and purpose of the prehistoric forts of Aran, the origin and meaning of New Grange, oghams and other matters, fresh evidence or a change of view have necessitated a restatement and recapitulation.

One of the most important of such matters to which the author has given reconsideration is the break in bronze age culture, which the evidence of pollen analysis, not available to him at the time of writing, has now shown to come at the close of a climatic optimum. In attributing the cultural eminence of the early bronze age not merely to wealth in gold, but also to the effects of a more favourable climate, the author has stressed an influence which he sees at work throughout Ireland's cultural history, and holds responsible for the cultural break between north and south—a break marked from the earliest times as in the distribution of the horned cairn, down to the present political division between Northern Ireland and the Free State, in which a bracing north-east is opposed to the enervating south and west.

On many questions—not least, perhaps, on the Celtic problem itself—Prof. Macalister finds himself at a loss, in view of the gaps in systematic study of Irish antiquities. The present activities of the State may possibly hold out promise of better things. In the meantime, Prof. Macalister, with his many and often brilliant suggestions, offers a plenitude of material for further discussion. He never fails to be provocative, even when most convincing.

Hormone und innere Sekretion. Von Prof. Dr. Fritz Laquer. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 19.) Zweite verbesserte und bedeutend erweiterte Auflage. Pp. xii+368. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 18 gold marks.

THE second edition of this very thorough work of reference follows seven years after the first. Dr. Laquer (who should not be confused with Dr. Laqueur, the distinguished Dutch physiologist working in the same field) has himself been very active in hormone and vitamin research, and it is all the more creditable that this should not have involved the restriction of his bibliographic activities.

The present book is an extremely useful consequence of those activities, covering, with abundant references and literature indexes, the whole field of endocrinology in its chemical and physiological aspects. To have done this in 368 pages, which include 6 pages of index and 126 pages of literature references, involves immense condensation, and leaves little room for any expression of the author's own opinions. Perhaps, in a field where to-day so much is speculation and controversy, this is not altogether to be regretted. An indication of the relative apportionment of subject matter can be obtained by considering the bibliographical references. To the general section there are 123; to the sections on the enzymes of the pancreas, thyroid, parathyroid, adrenal, pituitary, reproductive, and miscellaneous glands (including the thymus, spleen, intestinal tract, pineal body, etc.) there are respectively 1,245, 1,000, 337, 1,092, 1,237, 910, 688.

For these references alone the book is one to be welcomed; it is only the specialised experts working in each individual field who can precisely assess the value of the book in its particular aspects.

A. L. B.

The Application of Absorption Spectra to the Study of Vitamins and Hormones. By Dr. R. A. Morton. Pp. 70+6 plates. (London: Adam Hilger, Ltd., n.d.) 10*s*. net.

THIS small volume, which deals mainly with vitamins and scarcely at all with hormones, gives a concise and excellent summary of the achievements of absorption spectroscopy as a valuable adjunct in the isolation and identification of naturally occurring compounds which are present in extremely low concentrations. Dr. Morton's own investigations have played a prominent part in relation to the work on vitamins A and D, and it is unfortunate that the relatively high price will prevent this book from finding its way into the hands of many biochemical research workers who would find much of interest and of value in its pages.

The book is usefully illustrated by plates and figures, and a noteworthy feature is the table of carotenoids and their distinguishing properties. The amazingly rapid progress now being made in the chemistry of the vitamins and hormones is responsible for the fact that some of the sections are already out of date to some extent. Various phases in the application of spectroscopic methods are well brought out: first, the uncertainty as to the significance of the absorption bands given by crude extracts; then the use of the characteristic spectrum in the concentration of the active principle; and finally, the application to the quantitative evaluation of the vitamin.

***The Statesman's Year-Book**: Statistical and Historical Annual of the States of the World for the Year 1935.* Edited by Dr. M. Epstein. Seventy-second Annual Publication: Revised after Official Returns. Pp. xxxvi+1488. (London: Macmillan and Co., Ltd., 1935.) 20*s*. net.

THE new edition of this well-known book of reference maintains the familiar arrangement of past years, which gives rather more than a third of the book to the British Empire and the United States, and the remainder to the other States of the world with their Colonies and Dependencies, arranged in alphabetical order. The account of each State ends with a long list of useful books and there is a voluminous index to every place name. The volume has undergone the usual thorough revision and contains a marvellous array of recent statistical matter relating to area, population, finance and trade, besides ample accounts of constitutions and Governments. Unsettled as the state of the world is at present, there have been no transferences of territory of importance except the Saar, no emergence of new States and no disappearance of old ones during the year. Manchuria still appears under its old name as a territory of China, although a coloured map shows Manchukuo according to Japanese sources. A second coloured map shows the Saharan area ceded to Italy by the Anglo-Egyptian Sudan in the Libyan boundary settlement.

L'Espèce, la race, et le métissage en anthropologie: introduction à l'étude de l'anthropologie générale. Par Henri Neuville. (Archives de l'Institut de Paléontologie humaine, Mémoire 11.) Pp. iii+515. (Paris: Masson et Cie, 1933.) 200 francs.

THE publication of an intensive study of 'race' and attendant problems is a new departure for the Institut de Paléontologie, which the author justifies by his views of its relationship to the objectives of the study of human palæontology and archæology. M. Neuville's interpretation of the result of the geographical position of Europe and its function as a terminal point in racial migration is illuminating in relation to the consideration of the origin and distribution of racial characters in that continent.

The most important section in this study of race, however, is that which covers the study of material relating to the crosses of different races, in which the valuable but not too well-known data from the French colonies of Annam and Tonquin and West Africa are set out and considered in some detail.

A Text-Book of Quantitative Chemical Analysis. By Dr. A. C. Cumming and Dr. S. A. Kay. Sixth edition, revised by F. C. Guthrie and J. T. Nance. Pp. xv+482. (London and Edinburgh: Gurney and Jackson, 1934.) 15*s*. net.

ORIGINATING in 1913, this book has now reached its sixth edition—no better testimonial can be desired. The revision has been undertaken by Messrs. Guthrie and Nance, both lecturers in the University of Liverpool. Needless to say, the book has been brought up-to-date, for there is progress in this as in other branches of chemistry. Very properly 'ml.' has been substituted for 'c.c.' The changes which are indicated in the preface include recent methods for calibrating volumetric apparatus and determining hydrion concentration. The enhanced use of electrolytic methods is given due attention and the same applies to colorimetric methods, for which a number of new reagents have been described. In addition to what may be described as general analysis, the book has chapters relating to the analysis of ores and alloys, of gas and water.

Chemical Industry and Carl Duisberg

By PROF HENRY E ARMSTRONG, F R S

"ALAS, poor Yorrick! I knew him, Horatio: a fellow of infinite jest, of most excellent fancy " Geheimer Regierungsrat Carl Duisberg, honorary university senator, professor and *doctor in all faculties, including theology*, was born on September 29, 1861; he died on March 19, 1935. In telling his story, the history is told in large part of the most intricate and far-reaching of modern industries—also the history of an unparalleled advance, due wholly to the considered use of scientific endeavour by a nation, an advance involving incidentally a vast increase in man's knowledge of himself, of his power over himself and the world—all this the growth of only four fifths of a century! Curiously enough, the upgrowth of Germany as an industrial nation has been almost coincident with that of Japan. Whilst, however, the constructive advance of Germany has been intellectual and original, the advance of Japan has been imitative and mechanical: she has given no evidence of any special intellectual advance, such as has been apparent in India, for example, in a remarkable development of mathematical physics. It is, however, possible that we are too simple-minded to plumb her actions. Being free from our Western traditions and prejudices, especially from our stubborn individuality, maybe the Japanese have fathomed the value of scientific method, indeed of method in general, as we certainly have not: that consequently they are working to a clearly conceived plan. If so, they will be very dangerous as rivals. At least, they have the courage of their convictions and do things.

At the moment, Germany is abandoning the method to which she owes her success: Is she to continue on the down grade or to recover her liberty of thought and action? Is Japan likely to advance sufficiently in intellectual power to sustain the great burden she has undertaken: is this not already too heavy? May it not be that her arrogance comes from the fact that the old military element is regaining ascendancy? Having been a student in Germany before the war of 1870, having soon afterwards had as colleagues two of the men who shortly before had been instructors of the Japanese in our Western arts, I have long been more than an interested observer of the march of events. The one great point in favour of the Japanese is that they seem to be able to learn a lesson; our European characteristic is that we cannot and that our rulers are ascientific—playing dangerously only upon the credulity of the masses, without understanding the true state of affairs.

By Carl Duisberg's death, Germany is deprived of one of the greatest and most valuable citizens she has ever had; in the legend of the future, he may well come to be considered the most efficient and effective industrialist the world has yet known—he played with consummate skill so varied a part, with such unusual forcefulness of character, clearness of understanding and breadth of outlook, ever with entire devotion to his country and to his chosen and beloved science. The foundations of his success were certainly laid at the university, in Germany long the accustomed resort of the intelligent, including the upper commercial class—not the mere scholarship-fed, aimlessly competitive racing stables into which we have allowed ours to drift.

The story of Duisberg's early career is profoundly interesting. His father, a silk riband manufacturer and merchant, wished him to enter the business but he was attracted to chemistry while still at school. Leaving properly early, he went to Gottingen, then to Jena. He had taken his degree when he was twenty, before the close of his sixth semester. At Göttingen, he first came under Jannasch, who set him to work at complex analysis. In the second semester he was under Hubner, who used him to study the bromination of benzoic acid. Finding, at the end of the year when he almost had a thesis ready, that he could not take a degree at Gottingen, as he had been at a non-classical *oberreal-schule*—moreover, that in any case he must continue his studies during four more semesters—he went to Jena. He most fortunately came under Geuther, long an assistant to the great Wöhler, the steadying philosophic influence in the Liebig-Wohler partnership. Geuther was incensed when he learnt how Duisberg had been treated—that he had had no drill in preparation making. He insisted on his going through a full course of disciplinary exercises, both inorganic and organic, in laboratory technique, making him work with the simplest means. Eventually he gave him a theme for his doctorate—of course, dealing with aceto-acetic ether, of which Geuther (together with Frankland and Duppa) was the discoverer. His chief subject was chemistry, with geology, mineralogy and national economy as secondaries—in choosing the last the child was father to the man.

Having taken his degree, anxious to be independent of his father, without informing his teacher, Duisberg sought and obtained a post in the public food analytical laboratory at Crefeld. Evidently seeing how great was his ability, Geuther indignantly insisted that he must not so demean himself He had no assistantship vacant but made him his private assistant, according to Duisberg's own statement, in his obituary notice of Geuther (*Ber* , Oct 15, 1930), at the princely pay of 80 marks—instead of the usual 100—with a garret above the laboratory to live in In the book issued at the time of his seventieth birthday ("Carl Duisberg, ein deutscher Industrieller"), Duisberg is made to say that he was paid 1,000 marks, instead of the usual 1,200, plus the garret So is history written ! Geuther stipulated that he should not leave him until he obtained a suitable industrial post. The year must have been invaluable to him The curtain fell dramatically on the smash of glass ! Finding that no one would employ him until he was *militarfrei*, Duisberg decided to join up at Munich Geuther, when told of his intention, bitterly resented his leaving, insisting that he must keep his bargain The end came one day when, after angry discussion at his bench, Duisberg followed his master out of the laboratory brandishing in his face a large globular flask which he had been cleaning , eventually, as he reached the door, flinging this violently at his feet Repentance came at once Calling upon the Rector, he told him what had happened and that he feared Geuther would make it impossible for him to become an officer Evidently the Rector sympathised, as he advised him not to take the occurrence too seriously but to go to Munich. Such was the dramatic ending of his university career He left magnificently trained

At Munich, while serving as *Freiwilliger*, Duisberg worked in his spare time under von Pechmann , probably he was a little too lively for Baeyer. At the end of this year of military service, he was engaged, with two others, by Karl Rumpf, head of the Farbenfabriken vormals F Bayer & Co , Elberfeld Owing to the slump in alizarin, the firm was in queer street, paying nothing Rumpf gave his assistant his first real lesson in economics, teaching him that it was necessary to spend in order to earn The three young men were sent to different university laboratories, as no place could be found for them in the works. Duisberg went to Fittig's laboratory at Strassburg , history does not tell us what happened—they were very opposite characters. He began work on the synthesis of indigo, without result He then passed over to the study of azo-dyestuffs from benzidine and made orthotolidine, its next homologue At the end of a year, in the autumn of 1884, he entered the factory at Elberfeld, never to leave the firm except to translate it from a narrow, confined valley to a great open site at Leverkusen on the banks of the Rhine, taking no mean share of Rheingold treasure by so doing. He rose to gain for the firm a position as high as that attained to by any of its great rivals , moreover, not only to be its head but also the head of German chemical industry in general ; in fact, he became a great man of affairs

Why is it that, with very few exceptions, our chemists insist on remaining public nobodies and play but an underground part in industry ? Duisberg was made by his university training, as not a few of his countrymen have been We cannot point to a single similar success of our ancient universities in constructional industry Can we doubt that the competitive, superficial, unimaginative training—mere knowledge worship—now given at these, following upon the neglect of all scientific training at our monastic, certificate-hunting public and other schools, is the main cause of our continued failure ? Notwithstanding the lesson we have had, our industry to-day is in no way efficiently officered. The Germans have known what *Lern* and *Lehr-freheit* are—their success has been due to the way in which their universities have been free institutions. Now they are being deprived of them Freedom is an unknown quantity to-day in our schools , half a dozen examiners control them all and make them pipe to one tune No experiment can be made Until and unless we place education under liberal, scientific control, until we displace the clerical type of mind by the practical, no progress will be possible for us We are doing nothing to develop and cultivate our innately practical intelligence , instead we are sterilising it by mere book worship In consequence of our training, our so-called science on the theoretical side is mere faith worship , dogmatic and doctrinal, not eternal doubt , no thought of public need behind it

Duisberg came upon the scene at a propitious time ; the fates conspired to help him It is an interesting fact that his first technical work was inspired by a message from England—from a house-top in Burton-on-Trent, the roof laboratory of the chemist at Allsopp's brewery, Peter Griess, the father of diazo-chemistry and of the azo-dyestuff industry, in virtue of the work he did while assistant to the great Hofmann at the College of Chemistry, Oxford Street, afterwards at Burton-on-Trent, in amplification of the discovery which he had made when a student at Marburg Griess had submitted proposals to the Bayer firm for the preparation of certain benzidine sulphonic derivatives and their use in making azo-dyestuffs. The task was placed in Duisberg's hands to develop technically. Beginning at Strassburg, he continued the work when he joined the Elberfeld factory in September 1884. He soon succeeded where others less skilled had failed in preparing Griess's benzidine-sulphon-disulphonic acid and in making from this a dyestuff for wool, *sulphonazurin*, which was patented in their joint names. Although this did not answer expectations, the way was prepared, as the Elberfeld atmosphere became charged with benzidine nuclei

On February 27, 1884, Paul Bottiger, up to the end of 1883 in the employ of the Bayer firm, patented the dyestuff which was to become known as Congo Red, the first dyestuff discovered with which it was possible to dye cotton directly I have reason to believe that Griess had previously made this and discussed its merits adversely with his friend Heinrich Caro, a leading member of the great Badische Anilin und Soda Fabrik, who, however, with Dr Martius, had gained his experience in dyestuff chemistry, in Manchester, with Roberts, Dale & Co Both the Badische and Duisberg's firm declined to purchase the patent Böttiger then offered it to Dr Martius's firm in Berlin Martius was also about to decline it, when a friend, a dyer, happened to call upon him and noticed the dyed samples upon his desk, being told of its properties, he displayed great interest in the dyestuff on account of its power of dyeing cotton directly.

The Berlin firm secured the patent and soon put the dyestuff upon the market as Congo Red It excited the greatest interest among dyers, although supersensitive to acids, because of its special behaviour to cotton. Bayers were naturally sore, and it is easy to imagine the chagrin of young Duisberg at having so high a trump taken out of his hand. He at once hoisted the Jolly Roger, which was to become the flag of the industry The dyestuff had two components *A* and *B* It was open to him to vary either He chose to vary *A*, benzidine, having already made its first homologue, ortho-tolidine Here he all but failed to recognise that he again held trumps In his first trials, he obtained only a brown mess, of no promise. He had the habit, however, of putting his beakers aside as he used them, clearing up only at the end of the week. When doing this, he noticed that the brown mess had turned into a scarlet Following up the clue, he discovered that the coupling of *A* and *B* took place only very slowly In thus discovering Benzopurpurin, he made the first effective, direct cotton dyeing dyestuff

A new field was doubly disclosed—up to that time no systematic use had been made of homologues On this account, much difficulty was experienced in securing a patent The Martius firm naturally objected to such a rival to Congo but in the end the two firms agreed to work together. Then a rival firm that had been cited for infringement of the Congo patent brought an action to invalidate the patent. In the end, all opposition was overcome and the patent declared valid largely through Duisberg's own enthusiastic pleadings before the expert court. His value to the firm was greatly enhanced through this. Benzopurpurin, being far less sensitive to acid than Congo Red, was a great commercial success In the second year of its manufacture, Duisberg's share of the profits was already 10,000 marks (£500), which he at once invested in the firm's shares

The effect of Duisberg's success was to stimulate, in an astounding degree, the development of systematic, scientific laboratory inquiry as chief objective of the industry The Bayer firm, under his enthusiastic guidance, may be said to have led the way Not only were new dyestuffs produced in endless variety of colour and shade, their use was also systematically studied in the dyeing laboratory The British dyers became mere tools of the German dyestuff makers, though lubrication with no little palm oil was needed to overcome their intense conservatism and rule of thumb methods

Duisberg had no little luck The opening up of the tetrazo-field involved a great extension of the range of synthetic dyestuff colour The diazo-colours previously on the market had been yellows and reds, Congo made from aminonaphthalene-suphonic acid was also red Substituting naphth*ol*-sulphonic acid for the naphthyl*amine* acid, so increasing the light absorbing power of the dyestuff, Duisberg obtained a blue but of an undesirable red shade He relates how, sleeping at home after lunch (he had not yet an orchard), he dreamt that if he were to displace the methyl in ortho-tolidine by methoxyl he would introduce a green shade and so obtain a blue akin to indigo. The dream came true He was beginning subconsciously to theorise about the conditions determining visible colour Accident was to carry him still further In manufacturing the dyestuff, large quantities of paranitrophenol were accumulated, this was put into casks and kept for a rainy day Various attempts were made to find a use for it, without success—until one day the news came that two medical men had been poisoned by a druggist mistakenly dispensing acetanilide for naphthalene This led to the recognition of the antipyretic value of acetanilide and to its sale by Kalle and Co as Antifebrin in large quantity Why not ethylate and reduce paranitrophenol, said Duisberg. He therefore had it converted into ethoxyacetanilide, phenacetin This proved to be even better than antifebrin. In undertaking the manufacture of phenacetin, together with that of sulphonal and trional, the firm embarked upon a new important branch of activity, in which they became leaders Aspirin followed in a remarkable way. Some genius in the firm, if not Duisberg, bodily lifted into a patent specification a paper in *Liebig's Annalen* describing the preparation and properties of acetylsalicylic acid. Of course, the patent was lost when attacked in the Courts—but no matter. The name *Aspirin*, which Duisberg had registered as a trade mark, still remained and gave the holders almost a monopoly. What's in a name ? Everything ! Names are not all equally sweet. The challenge to take an Aspirin is easily uttered—no one would think of asking for an Acetylsalicylic acid. Duisberg always prided himself upon being a judge of 'technical effect', in no other case was this better shown.

Gradually, as the firm prospered, Duisberg's productive activity as chemist gave way to a more general activity. In 1900, he entered the directorate and became mainly occupied in erecting a great new works at Leverkusen, which in every particular bears witness to his creative ability. He was particularly proud of the provision he made for the welfare of the workpeople. After the War, he was largely occupied in the first place in organising the dyestuff industry, then German chemical industry as a whole—a task for which he was eminently suited by his masterful character, his great experience and above all his organising ability. The appreciation showered upon him on the occasion of his seventieth birthday was overwhelming in extent and sincerity.

Duisberg was much helped by Henry Böttinger, who had married into the firm before he entered it. Up to the time of his majority, Bottinger had lived at Burton-on-Trent, where his father was chemist at Allsopp's brewery. He was so entirely anglicised, that he spoke German as if he were thinking in English. He took charge of the firm's external affairs and laid the foundation of their great success in Eastern markets. I have a presentation copy of a tremendous quarto tome, beautifully got up entirely in the works, a lithographed reproduction in script of the letters Böttinger wrote home to his family during his travels in India and China. He not only placed the firm's goods but also arranged for training centres in India at which instruction in dyeing was given to buyers of their dyestuffs. The use of native-grown vegetable dyes in the East was thereby greatly curtailed. Now indigo is almost supplanted by synthetic indigotin, although if the industry were organised the natural dyestuff could be produced with advantage. Böttinger was so active-minded that later on he became a Member of Parliament. Eventually, he was *veradelt*.

I have sketched Duisberg's character more than once during the War, in *The Observer*; in *Chemistry and Industry* (March 27, 1931), apropos of an obituary notice of his great master Geuther which he had written for the German Chemical Society, recently (March 29) in *The Times*. He must have been a lively youth. When I first knew him, soon after he went to Elberfeld, in the first blush of his success, he was the perfect Gascon, filled with an astounding conceit—really this was his great asset. So late as 1906, at our celebration of the jubilee of Perkin's discovery of the first aniline dyestuff, with complete unconcern and full belief in his words, he told us that we must regard Germans as God's own chemists, heaven sent beings with whom it would be absurd for the world to enter into competition. Some of us smiled. We had discussed our position and long lamented our commercial weakness. Perkin, it is true, had been beaten from the field. Still, he had to his credit not only that he had made his discovery but had also started works by the time he was nineteen, without any Geuther to train him. Later, he was the first in the field as the maker of alizarin. Faraday, in 1825, had discovered benzene and analysed it accurately, even made the two naphthalenesulphonic acids out of which Teutonic chemists were to win fortunes, he had done not a little other chemical work. Lancaster had bred a chemist in Frankland. Personally, I had played to some effect with naphthalene and knew something of the colour game. I did not despair of our some day again wearing the shoes we had cast off too early; I knew we had recruits in the background. In fact, when Duisberg addressed us, the spirit was already at work in our Teutonic friends that made the late War inevitable. His own son, in saying "Good-bye" to my sons, in Lakeland, not very long before the War, expressed the hope that at no distant date he would meet them "on the field"; he even looked forward to becoming part owner of Derwentwater. This is sober fact. The German is a complex character. As chemists, it is essential for us to learn to dissect out the elements of his mentality. Having spent nearly three years as a student in Germany before the War of 1870, I have been witness of some of his interactions. Before '70, they were a primitive, almost pastoral, music-loving nation, wonderfully intelligent and absolutely indefatigable workers, asking only to be well led and ever willing to be led, almost child-like in their simplicity. On the other hand, they were curiously lacking in sense of proportion and without humour, you had not far to go below the surface to meet with unpleasant if not barbaric reactions, such as Wagner has brought out most wonderfully in his tetralogy—such as the Red Queen saw in Alice: "A nasty vicious temper".

Duisberg had lacked the critical power, characteristic of his nation, to see sufficiently below the surface. He knew quite well that our failure was mainly commercial and that our university system was greatly in fault He was too much overcome by his countrymen's overwhelming success in the industrial field , he did not see that no real attempt had been made by the world to meet their competition The world, in fact, had been hypnotised by Germany's ordered progress

Our action after the War was stupid We allowed lawyers to put themselves in charge These were followed by so-called business men We have yet to give technical knowledge and efficiency their due place This will ultimately be our sole chance of securing our proper share in the world's work Our recent partial success in re-establishing the dyestuff industry may largely be attributed to the example set by Mr James Morton, whose acute mind led him to surround himself with a picked band of competent workers and to accept their guidance unreservedly The outstanding service rendered by his chief assistant, the late Dr Thomas, has yet to be sufficiently recognised ; he was the nearest approach to a Duisberg we have had We have to take pains that we may breed such men—at present our schools are worthless for the purpose—indeed, they prevent them from arriving. If our industry is to prosper, we must abolish all clerical control of education and put it under men of scientific outlook—men who not only know something but also know how to use knowledge The present ignorance of the schools will never give us this. The future of the dyestuff industry will depend entirely upon the attitude of the public towards colour—upon the development of the colour sense The present world tendency is to abandon colour—everywhere black prevails an almost lost sense has to be recovered

Chemists belong to no nation the world over they are a community , one in spirit, in thought and in method, interdependent in their work. Eventually they must lead the world, as they alone can understand its operations The service Duisberg rendered was to the common good All can recognise the worth of the man, apart from his nationality , the value of the great example he set, apart from his technical service, by the exercise of a wide public activity and a wide philanthropy. Only by the aid of such men will the world eventually be sufficiently brought together in harmonious interrelationship

Quantum Mechanics as a Physical Theory

THE issue of the *Physical Review* dated May 15 contains a contribution by Prof A Einstein, B Podolsky and N Rosen under the title "Can Quantum - Mechanical Description of Physical Reality be Considered Complete ?" The authors answer this question in the negative They begin by pointing out that it is important to draw a distinction between the physical concepts, which are introduced into a theory and form its subject matter, and the objective reality, which is independent of the theory and which it is the purpose of the theory to describe. That is to say, we have to draw a distinction between the results of experiment and our theoretical description of them.

In order to test a theory the authors ask two questions . (1) Is the theory correct ? And (2), Is it complete ? The content of the paper is a consideration of the answers obtained when these questions are applied to quantum mechanics.

The first question can be answered in the affirmative if the theoretical conclusions agree with experiment. In physics, we test correctness by means of numerical values, and in this respect the authors have no adverse criticism to make of the quantum theory The second question is a more difficult one, and some explanation of its meaning is required before an answer can be attempted. A complete theory is understood to be one which provides a counterpart to each element of physical reality The definition of physical reality lies at the root of all that follows in the paper. The authors say If, without in any way disturbing a system, we can predict with certainty the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity They accept this as a reasonable criterion They do not regard it as a necessary but as a sufficient condition of reality

Accepting this definition, the authors go on to show that the quantum-mechanical description of physical reality is *not complete* The first step in the argument is to show that the uncertainty principle places two alternatives before us Suppose that two physical quantities are represented in the theory of quantum mechanics by the operators A and B If these operators do not commute, that is, $AB \neq BA$, then the theory maintains that precise knowledge of one quantity is incompatible with precise knowledge of the other The best known example of this is that in which the physical quantities are the co-ordinate of position and the momentum of an electron We can only obtain precise knowledge of the second quantity by experiment, and in attempting this we destroy our knowledge of the first. But both operators represent objects of physical reality, so that by the definition it must be concluded either that the theory does not contain concepts for both, that is, it is incomplete, or else the two quantities have not physical reality at the same time In quantum mechanics it is assumed that the wave function contains a complete description of this reality for the state to which it corresponds This is reasonable, since the information obtainable from this function corresponds exactly to that which can be predicted with certainty without altering the state of the system

In the final stage of the argument, an appeal is made to the process known as reduction of the wave packet. We must refer to the original paper for the details, but it is deduced that it is possible to predict with certainty two quantities corresponding to physical realities, and moreover that these quantities are represented by non-commuting operators. Thus we have to admit that if the quantum theory is complete and therefore contains concepts for these quantities then, although non-commuting, they correspond simultaneously to physical realities

We saw that the uncertainty principle presented us with two alternatives, and now we see that if we deny the first of these alternatives, we have also to deny the second The conclusion is that the first alternative, that the quantum theory is incomplete, has to be accepted

It is possible that the criticism does not strike at the root of the quantum theory, since so much depends upon a definition of physical reality, which is not of necessity included in the theory. If we could be satisfied that the definition is necessary or that without it two simultaneous conjugate physical quantities are represented by commuting variables, then the quantum theory fails. An interesting letter on this point from Prof. G Temple appears in NATURE of June 8 (p. 957).

The paper by Einstein and his collaborators is rather to be regarded as an appeal for a more direct description of the phenomena of physics. The authors seem to prefer the artists' portrayal of the landscape rather than a conventional representation of its detail by symbols which bear no relation to its form and colour. The expression of a belief that it is possible to provide a complete description of physical reality indicates the nature and purpose of the criticism. Presumably the appeal is for a replacement of the operator calculus of the quantum theory by a method of description which resembles that of the classical and relativistic theories in that, like them, it introduces concepts more directly corresponding to physical realities

In criticising quantum mechanics in this way, we must remember that it arose out of the inadequacy of existing models, and it has evolved in its particular way because it has had to do without them The theory has done what, in the face of difficulty, it set out to do It does not profess to describe actual phenomena but the possible results of measurements, and it is particularly concerned with the influence of the observer on the quantities observed Much work is being done at present on the notation of the quantum theory. There are difficulties to be removed and with their removal we may find that we have travelled in the direction desired by the three authors. Physicists can scarcely remain content with a situation in which the electron is an equation, and the remark sometimes heard that the school of quantum mechanics is content to establish itself merely as a bureau for ready reckoning is by no means true H T F.

U.S. Stratosphere Balloon *Explorer II*

A BRIEF reference was made in NATURE of February 23, p 299, to the remarkable preparations afoot in the United States to launch a new attempt in stratosphere research following on the mishap to *Explorer I* News has now come to hand that everything was ready by June 1 and the balloonists are only awaiting favourable weather conditions. The outstanding feature of this new experiment is the display of co-ordination of effort on the part of the National Geographic Society, the U.S. Army Air Corps and many of the public bodies interested in research. Capts. A. W. Stevens and O. A. Anderson will again ascend, and Capt. R. P. Williams is in charge of ground operations and has been named as alternative pilot.

Some idea of the magnitude of the task can be gained from the following details of the balloon and the experiments.

BALLOON

This was built and designed by the Goodyear Zeppelin Corporation, Ohio. When inflated it is 192 ft. in diameter and has a capacity of 3,700,000 cub ft and an area of 2⅔ acres. Its initial charge will be 300,000 cub ft. of helium, and with this 'bubble' of gas in it the top will rise 316 ft. from the ground when it is all complete and ready to start. The envelope is made of rubberised fabric, most of it weighing 5·3 oz. a square yard, at the top 7·2 oz. a square yard The gas can be released by two pneumatically operated valves near the top and there are four inverted open canvas chimneys in the bottom, 7·5 ft in diameter and 17 ft. long, to relieve it of surplus gas when fully inflated by the reduction of the external pressure

The total lift of the balloon on the ground is more than 8 tons. This figure includes the weight of the balloon itself, men, equipment and ballast The gondola is 9 ft in diameter and weighs 638 lb empty It is painted white both inside and externally above the equatorial plane and black below. An arm, 14 ft long, extends horizontally from it carrying a fan on the end, which supplies a tangential force to rotate the whole balloon The gondola is provided with an 80 ft round point triangular parachute operated by a pilot parachute to draw it from its bag.

INSTRUMENTS AND EQUIPMENT

The bag is provided with a 3-ft. dial thermometer near the top to be viewed directly from the gondola through porthole and vent For cosmic ray studies, Prof. R A. Millikan has supplied three ionisation chambers, one exposed, one in two inches of lead and one, weighing 600 lb , in four inches of lead Dr W F G Swann has supplied counter sets for various elevations from the horizontal, a lead-shielded chamber for 'bursts' and a Wilson expansion chamber. Mr. O H Gish has supplied an apparatus consisting of a vertical chimney external to the gondola 1 ft. in diameter and 3 ft high for a continuous ion count of the external air. Sun, sky and earth brightness records will be taken from outside the gondola, and records made of temperature and barometric pressure with resistance thermometer and short mercurial barometer respectively. The readings of the latter will be further checked by vertical camera studies of the ground and transit circle observations of the balloon made from the ground

The sun and sky light will be studied spectrographically both from within and without the gondola for ozone content of the stratosphere. Mention has already been made of the vertical camera for height observations, but other cameras will photograph the horizon to obtain the figure of the earth, and a motion picture camera is provided to record any moving events Air samples will be taken and spores collected, and even cultures of fruit flies are to be exposed to the rigours of the stratosphere. Finally, the observers will be in continuous radio communication with the ground on a transmission of 13,050 kilocycles per second, and a study will be attempted of the diffraction by the horizon of two sets of modulated waves emitted from the gondola aerial at 56,000 kilocycles and 112,000 kilocycles a second respectively

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News and Views

Retirement of Sir George Adam Smith

WHEN the autumn term begins, the Very Rev. Sir George Adam Smith will retire from the principalship of the University of Aberdeen. His long service of twenty-six years as principal exceeds that of any of his predecessors since the present University arose from the union of "The King's College" and "The Earl Marischal's College" on the passing of the first Universities Act of 1858. He has watched and guided the University during a period of notable development, when a demand for specialisation has increased the teaching staff by the addition of nine professorial chairs, three readerships, and forty-seven lectureships ; and when these changes, together with an increase in the number of students from 1,007 to 1,272, have required considerable additions to the fabric of the University itself. Of equal importance for the future of education and of scientific research has been the formation of linkages binding the University as a working unit with other institutions. In the present year the former United Free Church College in Aberdeen has joined with the University, and co-operation of great promise for the development of biological investigation in the north takes place with the Rowett Institute for Research in Animal Nutrition, the Macaulay Institute for Soil Research, the Scientific Laboratory of the Fishery Board for Scotland, and the Torry Research Station In the course of another year a new and vital link between the teaching and clinical aspects of medical subjects will be completed at the new Infirmary These developments, on which, in some directions, the future of the University depends, Sir George has guided with a tact and balance of mind and with a friendliness and humanity which have endeared him to his fellow-workers in the University ; and both town and University appreciate his services in ensuring that common appreciation, co-operation and goodwill unite the civic and academic interests of the community.

Valentin Magnan

THE eminent French psychiatrist, Valentin Jacques Joseph Magnan, the centenary of whose birth was celebrated on May 27 by a special meeting of the Société médico-psychologique, was born on March 16, 1835, at Perpignan, which was also the birthplace of three other celebrated French psychiatrists, Pinel, Esquirol and Falret. His medical education took place first at Lyons and then in Paris, where he qualified in 1866 with a thesis on the anatomical lesions in general paralysis. The following year he was appointed physician to the Asile Sainte-Anne, to which he was attached for forty-five years His most important work was concerned with the psychoses produced by alcoholism, in the modern investigation of which he was a pioneer, absinthe, in the prohibition of which in France he was mainly instrumental, and morphia; epilepsy, and sexual anomalies and aberrations. As director of Sainte-Anne, where he founded the Société clinique de médecine mentale, he was an enthusiastic advocate of the no restraint system and especially of the suppression of the straight-jacket His clinical lectures, which attracted numerous French and foreign physicians to Sainte-Anne, were for thirty years published in *Le Progrès Médical*, of which the issue for June 8 commemorates the centenary. In 1893 he was elected a member of the French Academy of Medicine, of which he became president in 1915 In his will he left the sum of 25,000 francs to the Academy for the foundation of a prize in psychiatry which bears his name His death took place on September 27, 1916, when he had reached the age of eighty-one years, his faculties remaining intact until the end.

Basutoland in Transition

FUNDAMENTAL changes in the life and economy of the natives of Basutoland are foreshadowed by the report (Cmd. 4907. H M Stationery Office) of the Commission, of which Sir Alan Pim is chairman, appointed by the Secretary of the Dominions to inquire into the financial and economic position of the country. The recommendations are drastic and affect almost every aspect of native life The gravity of the financial situation, which dictated the appointment of the Committee in the first instance, shows no sign of alleviation, and even in the improbable contingency that the proposals are entirely set aside, the force of circumstances alone, it would seem, will bring about disastrous changes which will lead to the breakdown of native culture and the system of administration. The spirit of independence and pride of race characteristic of the Basuto people should be preserved at all costs as the essential condition of their future progress. Their spirit is explicitly recognised in the Report as a dominant factor in the problem of reform; but it is pointed out that, unless rightly directed, it may prove an obstacle in the way of advance towards the goal the Commission has in view—the creation of a real system of 'indirect rule'. In the multiplicity of topics discussed and of ameliorative measures suggested, this is the major issue. While the financial situation of the Protectorate has undoubtedly complicated its political future, the internal situation and the formulation of a settled administrative policy which will afford opportunity for the development and utilisation of the admittedly favourable traits in native character and culture must obviously be a prior consideration to that of the eventual transfer of responsibility to the Union of South Africa.

R.A.F. Big Flying Boat

THE performance figures of the *Saraband* built by Short Brothers of Rochester for the R.A.F., just divulged for the first time although the machine was built in 1932, show that it is by far the largest flying boat in the R.A F equipment, and is more powerful than even the German *D O X* Its engines total 5,500 horse-power, maximum speed 150 miles an hour, climb 750 ft. a minute, with an air range of 1,450 miles, with full load In this respect it is worth remembering that many countries make a practice of reporting performance trials with specially lightened loads The machine has a wing span of 120 ft and is 90 ft long It carries a military load of 5,960 lb., which includes an automatic pilot, the usual machine guns, and a 1½ in automatic quick firer. The hull is a self-contained unit, containing sleeping accommodation for the crew, a workshop, a ward room, a drying compartment, an anchor winch, and gear for changing engines afloat. It is built entirely of steel and duralumin, and the hull design incorporates many novel structural features. A civil flying boat of the same size was under construction at the same time, but was stopped for reasons of economy.

Presentation of Prof Piccard's Gondola to the Science Museum

ON June 12, the gondola of the balloon in which Prof A Piccard and M Max Cosyns ascended into the stratosphere on August 18, 1932, was presented to the Science Museum, South Kensington, by M. Jean Willems, director of the Fonds National de la Recherche Scientifique, Brussels. His Excellency the Belgian Ambassador presided, and both Prof. Piccard and M. Cosyns were present. The gondola consists of an air-tight sphere (about 2 metres in diameter) of aluminium alloy, fitted with two manholes and several portholes, and equipped with various scientific instruments; it was attached to the hydrogen-filled balloon with which Prof. Piccard made his previous ascent on May 27, 1931. The second ascent, in 1932, was made from Dubendorf Aerodrome, near Zurich, and after a twelve-hour flight, the balloon landed safely. in a field at Cavallaro di Monzambano, about ten miles south of Lake Garda. The maximum height reached during the voyage (determined trigonometrically) was 16,940 metres (10½ miles). The main objective of the flight was the investigation of cosmic radiations. Observations were made to ascertain the variation of intensity of these rays with height, and the distribution of the radiation in different directions was studied by means of a tubular Geiger counter.

Early Design for an Aeroplane

THE Science Museum, South Kensington, has just acquired through the generosity of Mr. P. A. Smith of Scarborough a small disc of silver about an inch in diameter bearing an engraved design for a flying machine which is remarkable in conception. The disc bears the initials 'G.C.' with the letter 'R' beneath and it is dated 1799. The reverse contains a diagram of forces relative to the design illustrated.

There is little doubt that it is the work of Sir George Cayley, Bart (1774–1857), who was the first to attempt to explain mathematically the fundamental principles of mechanical flight The flying machine represented is a manually propelled (assisted) glider It is a large monoplane, the plane being curved, with the operator sitting in a boat-shaped structure below and working by means of levers two large rectangular oars or paddles which were probably intended to function on the non-return valve principle by means of flaps An interesting feature is the combined rudder and elevator arrangement which consists of surfaces fixed at right angles to one another, the whole, it appears, universally pivoted—a device which has been attributed to Alphonse Penaud at a much later date Research is being undertaken to discover the full significance of the design, but the disc has been placed on exhibition

The National Physical Laboratory

THE report of the Laboratory for the year 1934 is a well-illustrated and indexed quarto volume of 260 pages. Each of the eight departments of the Laboratory gives a short account of its principal activities in an interesting and thoroughly readable form The increase in activity in industry has produced a corresponding increase in the work carried out by the Laboratory, particularly in that relating to shipbuilding, and it has been necessary to call for overtime and to increase the staff The movement for the abatement of noise has resulted in demands on the Sound Department from the Ministries of Health and of Transport. The deaths of Sir Arthur Schuster, Sir Horace Lamb, Sir Alfred Ewing and Dr. W. Rosenhain have deprived the Laboratory of four of its friends and supporters, but the changes of staff have been slight. The lectures on the work of the Laboratory given at a number of provincial centres have been much appreciated, and are to be continued. The new buildings for photometry will probably be brought into use this year, new high-speed wind tunnels are already in operation and the Lithgow installation for testing propeller blades will be available next year. The comparison of standards of measurement of all kinds with those of other countries has been continued with satisfactory results. The sound-isolating properties of walls and partitions of many types have been investigated and field tests of actual buildings can now be carried out. The work on refrigeration and preservation of food of all kinds has been continued for the Food Investigation Board, and that on protection from and dosage of X-rays and radium, for the Medical Research Council. The lubricating value of the oils derived from the distillation of coal is being investigated, and the production and working of the extremely light alloys of magnesium are being tested. Rapid advances are being made in our knowledge of the structure of the ionosphere, on which so many of the phenomena of wireless communication depend.

The Grand Coulee Dam

THE Columbia River in the United States is second in size only to the Mississippi. Owing to the fact that its source is high in a region of melting snows in the mountains of western Canada and Montana, its discharge is more continuous than that of all the arid regions of the west and the middle west combined. In an article in the *Scientific American* of April, Grace Kirkpatrick gives an interesting account of the Grand Coulee (Grand Valley) dam which engineers are now busily constructing. In prehistoric times the Columbia River, then much larger than it is to-day, was dammed by a glacier, and the torrents of water which poured through the high cliffs bordering the river flowed down and formed the Grand Coulee. The walls of the valley are in some places 1,000 feet high The upper 20 miles of the river are being closed with dams at each end to form a huge reservoir. The Columbia River sweeps across the State of Washington and forms for many miles the border between Washington and Oregon. On the plateau above its canyon-like banks are millions of arid acres known as the Columbia Basin which if suitably irrigated would be one of the most fertile lands in the world. The dam is being built in two units—the high dam and the low dam. The latter is exclusively a power development while the high dam will be used for power, irrigation, storage and navigation development The dam will raise the waters of the Columbia so that they can be pumped into the reservoir of the Grand Coulee and will then flow over the parched acres of the Columbia Basin The blocking of the river will create the largest artificial lake in the world. It is 151 miles long and will extend into Canada. The spillway in the centre of the high dam will be 1,800 feet long and no less than 325 feet high.

Costs of Electric Lighting since 1910

THE lowering of the cost of the electric light during the last twenty-five years, mainly due to scientific research and improved engineering methods, is fully appreciated by few. In 1910, carbon filament lamps, which had held the foremost place since the inception of the incandescent lamp, were rapidly being replaced by tantalum and tungsten lamps giving almost twice as much light for the same electric power. In the same year, by means of the new 'squirted' filament lamp, the light-giving efficiency was more than doubled. In 1912 the drawn tungsten filament nearly trebled the efficiency. All these lamps were vacuum lamps. In 1916 the invention of the gas-filled lamp trebled the efficiency, and the latest type of gas-filled lamp, the 'coiled coil' lamp, has nearly quadrupled the light efficiency, giving 11·25 lumens (approximately 0·9 candle) per watt. Many consumers are now getting their electric light at a cost of 0·5*d*. per unit who had to pay 6*d*. or more per unit in 1910. Electrical engineers and scientific workers may well be proud of lowering the cost to one fiftieth of what it was in 1910.

Metallurgical Research

THE lecture given by Dr. H. Moore, director of the British Non-Ferrous Metals Research Association, before the London Section of the Institute of Metals on November 8, 1934, published in the March issue of the Institute's *Journal*, constituted an extremely valuable review of the more immediate past and future of metallurgical development. Under the title of "Recent Trends and Future Developments in Metallurgical Research", Dr. Moore surveyed the application of physical and physico-chemical methods to the study of metals and alloys, with particular reference to the industrial application of the results of research. In the period under review—the past decade—the output of metallurgical research has undoubtedly been unparalleled, but in Dr. Moore's view the main bulk of this large output has been concerned with the exploitation of fundamental concepts which had been developed more than ten years ago Research in progress at the present time is reviewed under six main heads. melting and solidification, working of metals, heat treatment, mechanical properties, corrosion, and electro-deposition, and the directions in which work may be expected to proceed in the near future are outlined. The impression gained from this exceptionally interesting and virile address is one of boundless fields of research, offering fascinating possibilities in the extension of the use of metals for a very wide range of purposes for the benefit of civilisation.

Science and Humanism

In the quest for a unity underlying the rich variety of the universe, philosophers are in constant danger of limiting themselves to unreal abstractions and verbal dialectic. Both those who call themselves pragmatists, as dealing with things rather than with words, and those who prefer the fuller name of humanists, find that science, the most objective of human experiences, has a large contribution to make to our general body of thought. As is pointed out by A. Rey in "Les Mathématiques en Grèce" (*Actualités Scientifiques*, 217. Paris: Hermann et Cie., 1935) the study of the history of science may be recommended on two grounds. It may make scientific thought more accessible to philosophers, and may do something to break down, among scientific workers themselves, that narrow specialisation which is so prevalent to-day. Among the ancient Greeks, as also in the Renaissance, both ages of humanism and free inquiry, science had a considerable place, though not an exclusive one. The humanism of to-day has at its disposal an embarrassing array of tempting dishes; the difficulty is to make a well-balanced selection from them, and to get the whole range of mental vitamins without suffering from hypervitaminosis.

Description and Identification of Species

In spite of the three quarters of a million species of animals which have been described binomially, it is remarkable how little there is of organised plan in the descriptions, taken as a whole. Some authors of new species are content with a few lines of characterisation, others seem to describe, not a species, but the total characters of an individual specimen. It is partly that species are not fixed, and that few writers, even on the same group, would agree upon the characters to be selected as criteria of specific rank, partly that the critical characters within different groups appear to be so diverse, that no common plan would fit more than a relatively few. Dr. Séverin Icard has made a bold attempt to standardise descriptions of species by advocating a method which he calls "la méthode des nombres signalétiques" (*Revue de Path. comp. Hyg. gen.*, Nov. 1934) It looks quite simple. Shortly, it is that, in regular order, parts of the specimen to be identified or described are examined, and the result for each part is represented by a number. The key to the parts to be examined for a particular group, and to the number corresponding to a particular character, say, legs yellow, is to be found in a set of "Tables de correspondance". Thus the special character of each part has its own particular number, a short-hand way of writing a description which normally would contain at least a few words for each part

Species Formula

In describing a beetle, for example, Dr. Icard chooses seven characters, always read in the same order—colour of thorax, colour of elytra, form of thorax, form of elytra, form of feet and tarsi, form of antennæ, form of head. Each character, in a particular specimen, is represented by a number—the *nombre signalétique* or descriptive number, so that the total description of the specimen as regards specific characters may be represented by a series of numbers—the *formule signalétique* or specific formula. We wish to identify a beetle; we translate one by one its characters into the appropriate number; then having composed our specific formula we search for this particular formula in another book of words, "Le Répertoire général", and if we find the formula there we shall also find opposite it the name of the species which possesses this characteristic association of characters It is an attractive idea that the plant and animal worlds should be so completely tabulated that a set of symbols would identify any of their members, and if the method would enforce upon describers of species definiteness in characterisation and brevity, it might be well worth a trial.

Suggested Biological Survey for Union of South Africa

In the *South African Journal of Science* (Nov. 1934, p. 396), Dr. R. Bigalke makes a plea for the inauguration of a biological survey in the Union. During 1911–33 the Provinces spent £607,674 in connexion with fish and game preservation and the destruction of vermin, and the suggestion is that a biological survey would furnish scientific information for the more efficient use of such expenditure. The survey would be a unit of the Department of Agriculture, and it would set in the forefront of its aims the solution of pressing economic problems, such as the biology and control of predatory animals, of noxious rodents, or rabies transmitters, and the relation of wild birds to agriculture. Before such investigations had progressed far, the need for faunistic surveys would become obvious, and for the prosecution of these co-operation would be sought with the various museums. The author estimates that such a survey could be set going with a staff of not less than six biologists, who should have taken zoology as a major subject and botany and geology as minors. But can any thorough study of fauna be carried out without recourse to fairly thorough statistical analysis, and the author says nothing about mathematical qualifications

The Men of the Trees

THE tenth annual report of the Society of the Men of the Trees reviews the work of the past year, which has shown an increased membership of the Society, inaugurated by Mr. St Barbe Baker The work of the year has included lectures, meetings and exhibitions. Of the latter, the chief was the International Picture Exhibition, held at Grosvenor *House, Park Lane, London, throughout November.* Thirty-seven countries assisted the exhibition by sending tree paintings by some of their foremost living artists, and also treasures from the national collections. Several addresses were delivered at meetings by Ambassadors and Ministers accredited to Great Britain The opening address was given by Field Marshal Viscount Allenby, who dwelt upon the importance of forestry and tree-planting in Great Britain to make good the wastage of the late War Lord Allenby, even before the War was over in Palestine, had started to restore the land by tree-planting, a commencement which inspired the Men of the Trees to carry on the work. Before opening the exhibition, Lady Georgiana Mure pointed out that forestry and the care of trees is a world-wide thing and that we can "meet our friends from Overseas on a common ground of good fellowship, occasioned by the mutual admiration and love of the countryside and its chief ornament, trees". Mr. Baker directed attention to the advantage from an æsthetic point of view, as well as the hygienic and economic, of planting up the slagheaps in the Black Country of England, and stated that a part of the proceeds from the exhibition was to be devoted to that object.

Cereal Synonyms

THE Cereal Synonym Committee has come to a number of decisions on the stocks of cereals which it examined in 1934. In arriving at these decisions, the Committee was guided by the following definition of a cereal synonym: "The Cereal Synonym Committee regard two cereals as synonyms when they present precisely similar morphological characters, and when they also possess identical physiological characters in so far as they can be determined. Even then by this term they do not necessarily imply that these two varieties are of identical origin, though doubtless in the majority of cases they are. The possibility of two cereals of different parentage presenting such a close, if not complete similarity as to mask their individuality has not been lost sight of. But the Committee have to deal with facts as they are; they, therefore, regard as synonyms all cereals which are identical in the sense used above even when they know that the origins are different. Before the Committee come to a conclusion concerning the synonymity of any variety the breeder and/or the introducer is given an opportunity of demonstrating to the Committee such differences as he may claim to exist between his variety and the type variety." In compliance with the request of the Committee that as much publicity as possible should be given to its decisions, the National Institute of Agricultural Botany, Cambridge, has published a leaflet giving full details of the findings for the wheat, oats and barley varieties investigated.

Review of Agricultural Research

THE Royal Agricultural Society of England has recently issued its *Journal* for 1934, vol 95. As last year, "The Farmer's Guide to Agricultural Research" *has been incorporated with the annual publication,* so that it may be available to every member of the Society At the same time a number of copies are being bound separately for distribution to the Press and to centres of agricultural education and research. This valuable survey of recent scientific work has been carried out on the same lines as in previous years and the authors responsible for the various sections, namely, crops and plant breeding, diseases of animals, farm implements and machinery, farm economics, dairy farming and dairy work, the feeding of livestock, and soils and fertilisers, are the same as in 1932 The work dealt with is not limited to research conducted in the British Isles, but includes references to results achieved in any part of the world from which light may be thrown on the problems of British agriculture A few copies of previous issues (1925–32) are still available.

British Standard Specifications for Laboratory Glassware

IN further development of the work which is now being carried out by a committee of the Chemical Division of the British Standards Institution in the standardisation of laboratory ware including scientific glassware, British standard specifications have just been issued for graduated measuring cylinders, Crow receivers, Nessler cylinders and Petri dishes. Copies of the specifications (Nos. 604, 605, 612 and 611–1935 respectively) may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S W.1, price 2*s*. 2*d*. each post paid.

New Museum of Practical Geology, South Kensington

THE opening of the new Museum of Practical Geology, South Kensington, London, S.W.7, and the celebrations of the centenary of the Geological Survey of Great Britain, will take place on July 3–4. The opening ceremony will be performed by H.R.H the Duke of York on July 3 at 3 p.m. A preliminary account of the proceedings appeared in NATURE of March 23, p. 463. In the final programme now issued, it is announced that the director of the

Geological Survey, Sir John Flett, will deliver an address on July 4 on the history and functions of the Museum, in the lecture hall of the Victoria and Albert Museum. Several geological excursions have been arranged to follow the celebrations, and delegates will have the opportunity of studying, under expert guidance, the Isle of Wight and mainland opposite, the Wealden district, South Wales and Bristol, or Edinburgh and surrounding country. Further information can be obtained from the Director, Geological Survey of Great Britain, Museum of Practical Geology, South Kensington, London, S.W 7

Announcements

We regret to announce the death, which occurred on June 14, at the age of seventy-six years, of Prof. J. B Cohen, F R S, emeritus professor of organic chemistry in the University of Leeds

The following awards of the Royal Aeronautical Society have recently been made *Society's Silver Medal*, Mr. C C. Walker and Major F B Halford; *Simms Gold Medal*, Dr L Aitchison; *Taylor Gold Medal*, Mr F. Rodwell Banks; *Busk Memorial Prize*, Dr H Roxbee Cox

The Trustees of the Lady Tata Memorial Fund announce that, on the recommendation of the Scientific Advisory Committee, they have made the following awards of scholarships and grants for the academic year 1935–36 These awards were open to suitably qualified persons of any nationality, for research work in diseases of the blood, with special reference to leukaemia *Scholarships* Dr M. C G. Israëls (Manchester), Dr. O Kaalund-Jörgensen (Aarhus). *Grants*: Prof W Bungeler (Danzig), Dr J Engelbreth-Holm (Copenhagen), Dr. Karl Hinsberg (Berlin), Dr Ch. Oberling (Paris), Prof Eugene Opie (New York), Dr. Lucy Wills (London).

A conference on some aspects of the metallic state will be held in the H H Wills Physical Laboratory, University of Bristol, on July 2–5 One of the University halls of residence will be available for those attending the conference, and anyone wishing to have accommodation reserved there is requested to communicate with Prof. N F. Mott, H H. Wills Physical Laboratory, The University, Royal Fort, Bristol, 8.

In connexion with the Noise Abatement Exhibition at the Science Museum, South Kensington, a conference at the Museum on June 26–28 has been arranged by the Anti-Noise League, 66 Victoria Street, S.W.1. The programme includes discussions on "Sound and Noise", to be opened by Dr. G. W. C. Kaye, of the National Physical Laboratory; on legal and housing aspects of noise; on the noise problem in relation to education; and on "Health and Noise", to be opened by Lord Horder.

It has recently been decided by the Italian Ministerial Council that the participation of Italians in International Congresses should depend on Italian being made one of the official languages.

We have received the commemoration number of the *Colliery Guardian and Journal of the Coal and Iron Trades*, which celebrates the 150th volume of that paper; as there are two volumes a year, this means that this paper has been issued for seventy-five years, no mean achievement for a technical paper The paper commences with a review of British coal mining during this period and with a brief account of the history of the journal since its formation. This is followed by a series of articles by various men well known in the colliery world for their eminence in the subjects which they have selected.

A prospectus has been circulated of the publication by Messrs McFarlane, Warde, McFarlane, of New York, of the illustrations of the "Anatomy of the Human Body", by Andreas Vesalius (1514–64). The drawings for this great work were made by John Stephen of Calcar in Cleves, a pupil of Titian. The book, a double crown folio (15 in. × 21½ in), will contain all the illustrations of the "Fabrica" and "Epitome", 228 plates have been printed from the original blocks, 227 of which have been preserved in the University of Munich, with the descriptive Latin text The work is edited by Drs. Lambert and Malloch of New York, and Willy Wiegand of the Bremer Press, Munich. The subscription price is 100 dollars

Applications are invited for the following appointments, on or before the dates mentioned.—A head of the Mechanical and Civil Engineering Department in the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (June 25). A district forest officer, and a district estate officer in the Forestry Commission—The Secretary, 9 Savile Row, London, W.1 (June 25). A lecturer in rural science and gardening in Bangor Normal College—The Registrar (June 28). A lecturer in mathematics and electrical transmission and distribution of power in the Derby Technical College, Green Lane, Derby—The Clerk to the Governors (June 29). A lecturer in engineering in Loughborough College—The Registrar (June 30). A lecturer in organic chemistry in University College, Exeter—The Registrar (July 1) A lecturer in agriculture and farm director in the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal (July 2). A lecturer in agricultural chemistry and physics in the Swanley Horticultural College for Women, Swanley, Kent—The Principal (July 8). A professor of mining in the University of Leeds—The Registrar (July 8). An assistant in the Admiralty Technical Pool (electrical engineering)—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 13). A botanist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7. A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 1042.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

What is a Colloid?

ASSOCIATION is the characteristic factor in the colloidal state.

Without it, no films, fibres, glasses, resins or plastics, no jellies, gels, liquid crystals, coagula or gelatinous precipitates, no high viscosity (Graham's colloidoscope), no opalescence, no colloidal particles built up of a myriad of ordinary atoms or molecules, no electrosmosis or streaming potential, no membrane equilibrium or any of the effects defined by Loeb as 'colloidal behaviour', no stabilising agents or protective action or sensitisation, no stability however transient of the great majority of colloidal particles which are dependent upon structural arrangement, not even the folding of the long chain molecules that gives the characteristic properties to such colloids as wool or rubber, none of the beautiful and varied architecture which utilises as building stones the colloidal particles, which are themselves products of association

In recent years there has been a tendency, particularly on the part of some who have been emphasising the immensely long chain structure of certain natural and synthetic colloids and their relation to viscosity in very dilute solution, to do away with the term micelle and to think only of the individual molecule as a single simple kinetic unit. However, since the convincing work of Sponsler, Dole, Meyer, Mark and Staudinger, no one now questions the long chain nature of such molecules as cellulose

Soaps are still recognised as association colloids, and the association of their molecules and ions is known to produce particles of orderly structure Yet this distinction is incompletely valid, for in dilute solution, to which Staudinger's formulations are confined, soaps are not colloids at all. As a matter of principle, in sufficient dilution in a suitable medium, all colloids are resolved into their molecular or ionic constituents, as happens with sols of WO_3 and V_2O_5 Few would care to deny association in higher concentrations, but are we to assume that in contrast to soaps or suspensions the association of long chain molecules is wholly disordered?

Whereas in dilute solution simple sulphonic acids, as will be shown in a series of articles elsewhere, consist of ordinary molecules and ions, in concentrations above $N/10$ association is so predominant as wholly to submerge the influences discussed in the interionic attraction theory The result is that effects such as conductivity, freezing point lowering, and electromotive force increase instead of decreasing with concentration. Association must be of the cohesive van der Waals' type, emphasising the principle of 'like to like'.

When association is so predominant in such simple cases, it must be important in the behaviour of chain molecules, and indeed must be a factor always to be reckoned with in all solutions.

JAMES W. MCBAIN.

Stanford University,
California. May 22.

Raman Spectra of Deuterobenzenes and the Structure of Benzene

THE letter by Klit and Langseth in NATURE of June 8 (p 956), recording Raman frequencies of some deuterobenzenes, leads us to report our own results so far as these overlap, although we had wished to reserve publication until the problem of which these spectra supply only part of the answer had been fully solved Klit and Langseth record 8 lines for C_6D_6, and 1 for each of C_6H_5D and C_6HD_5 (not obtained pure). This note relates to C_6D_6 and C_6H_5D (both pure); we have not prepared C_6HD_5; we have, however, examined 1.4–$C_6H_4D_2$ and hope to study 1:3:5–$C_6H_3D_3$ also, for the following reason

An acute problem concerning the structure of benzene was raised when Placzek showed[1] that the same fundamental frequencies cannot appear in both the Raman and infra-red spectra of molecules possessing a centre of symmetry. Bhagavantam[2] and Krishnamurti[3] had directed attention to several apparently coincident frequencies in these two spectra for benzene, and this seemed to show that benzene has not the plane regular hexagonal structure (point group D_{6h}) which the resonance theory requires. Various models of lower symmetry have been suggested by Placzek himself, and by Cabannes and Rousset[4], Deitz and Andrews[5], Weiler[6] and others One model of sufficient dissymmetry is the static Kékulé structure, but to revert to this would be retrograde on other grounds. The difficulty would disappear, however, if it could be shown that the coincidences are accidental, that is, that the identical or nearly identical frequencies depend in fact on different proper vibrations The problem is therefore to identify the proper vibrations, and this we shall do by measurement of the H–D displacements, first when the total symmetry of benzene is maintained as in C_6D_6, and secondly when different elements of symmetry are removed, as in 1.3:5–$C_6H_3D_3$, 1.4–$C_6H_4D_2$ and C_6H_5D At present we are studying the Raman, infra-red and ultra-violet spectra of C_6D_6, 1:4–$C_6H_4D_2$ and C_6H_5D.

	C_6H_6	C_6D_6		C_6H_5D	
	Literature	This Note	K and L.	This Note	K. and L.
(i)	607 (3)	583 (3)	582	609 (3) 785 (1)	— —
(ii)	849 (1)	666 (2)	845	855 (1)	—
(iii)	993 (10)	944 (10)	947	984 (10)	982
(iv)	1176 (3)	867 (3b)	870	1175 (5)	—
(v)	1585 (3b) 1606 (1)	1536 (3b) 1566 (3b)	1555 1569	1597 (5b)	—
(vi)	3049 (2)	2265 (3)	2267	2271 (2)	—
(vii)	3064 (5)	2292 (5)	2292	3059 (10b)	—

Our Raman frequencies for C_6D_6 and C_6H_5D are in the accompanying table; approximate intensities are given in parenthesis, but not polarisations, as these measurements are not yet complete The

C_6D_6, m.p. 6 8°, was prepared by our sulphuric acid method[7], and the C_6H_5D, m p. 5·5°, by the Grignard reaction. Klit and Langseth's frequencies (they do not record intensities) are added for comparison. The agreement is satisfactory, except for line (ii), which they find undisplaced in C_6D_6, whereas we observe a very striking shift. The self-consistent allocation of frequencies suggested below would have been impossible without this result Frequencies are in cm^{-1}.

No scheme of identification can be regarded as final which is based on only part of the evidence, but it is of interest that our C_6D_6 frequencies permit an allocation consistent with the symmetry D_{6h}. The proper vibrations of this benzene model have been formulated by E. B. Wilson[8], and Dr E. Teller has given us the results of an equivalent calculation and of an unpublished theorem leading to frequency relations by means of which any assumed model may be tested. This theorem relates to the product, $\Pi_N \nu$, of the frequencies, ν, of any complete set of proper vibrations of like symmetry, N; it gives, indeed, the quotient, $\tau^{1,2}_N = (\Pi_N \nu)_1/(\Pi_N \nu)_2$, for any two compounds 1 and 2, which differ only isotopically with respect to one or more of their atoms.

The D_{6h} benzene model requires seven Raman fundamentals, divisible into three symmetry classes having distinctive relations between the tensor components, c_{ik}, of the change of polarisability (6-fold axis = z). Class A' ($c_{xx} = c_{yy}$, $c_{ik} = 0$) contains two totally symmetrical ('breathing') frequencies, one involving mainly C–H stretching, and the other C–C stretching. Class C'' ($c_{ii} = c_{xy} = 0$) has one degenerate vibration corresponding to C–H bending perpendicular to the ring. Class D' ($c_{xx} = -c_{yy}$, $c_{zi} = 0$) comprises four degenerate frequencies, one dependent mainly on C–H stretching, one on C–H bending, and two on ring deformation, all in the plane of the ring. Applied to C_6H_6 and C_6D_6, Teller's theorem gives $\tau^{H,D}_{A'} = 1{\cdot}41$, $\tau^{H,D}_{C''} = 1{\cdot}29$, $\tau^{H,D}_{D'} = 2{\cdot}00$ (using distances C–C, 1·42, and C–H, 1·10 A).

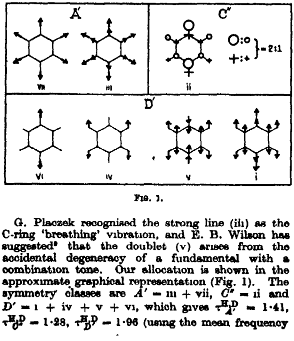

FIG. 1.

G. Placzek recognised the strong line (iii) as the C-ring 'breathing' vibration, and E. B. Wilson has suggested[9] that the doublet (v) arises from the accidental degeneracy of a fundamental with a combination tone. Our allocation is shown in the approximate graphical representation (Fig. 1). The symmetry classes are A' = iii + vii, C'' = ii and D' = i + iv + v + vi, which gives $\tau^{H,D}_{A'} = 1{\cdot}41$, $\tau^{H,D}_{C''} = 1{\cdot}28$, $\tau^{H,D}_{D'} = 1{\cdot}96$ (using the mean frequency of the doublet). Within classes A' and D' the separate approximate vibrations are allocated by means of the frequencies and the frequency shifts.

W. R. ANGUS. A. H. LECKIE.
C. R. BAILEY. C. G. RAISIN.
J. L. GLEAVE. C. L. WILSON.
C. K. INGOLD.

University College,
London.
June 8.

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[1] Leipziger Vorträge, 1931, p 100, *et. seq.*

[2] *Indian J. Phys*, 5, 615, 1930

[3] *ibid*, 6, 543; 1932

[4] *Ann Phys*, 19, 229, 1933.

[5] *J Chem. Phys*, 1, 62, 1933

[6] *Z. Phys.*, 85, 58; 1934.

[7] NATURE, 134, 734; 1934.

[8] *Phys Rev*, 45, 706; 1934

[9] *ibid*, 46, 146, 1934.

A New Nitrogen Afterglow Spectrum

IN a communication in these columns[1] I directed attention to the presence of two members of the Vegard-Kaplan system of nitrogen in the spectrum of the afterglow that was discovered by me in 1934[2]. Although very weak, the presence of these bands was the first direct proof of the existence of metastable molecules in active nitrogen. The spectrum of this afterglow was a very faithful reproduction of the auroral spectrum

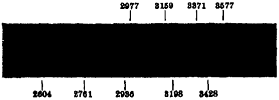

FIG 1.

I have recently photographed the spectrum of the afterglow which is produced when the current is greatly diminished relative to that which produces the auroral afterglow. In fact, the current was so small that the discharge in the tube was barely visible. The spectrum of this afterglow is shown in Fig. 1, and it differs from the 1934 afterglow in the absence of the first-negative bands of N_2^+ and in the great enhancement of the relative intensity of the Vegard-Kaplan bands. The wave-lengths of some of the members of this system are marked on the bottom of the figure and those of the second-positive system on the top. When it is recalled that the Vegard-Kaplan system is emitted by the $A^3\Sigma$ metastable molecule, the remarkable nature of this spectrum is realised. The intensity of this system relative to the second-positive bands is much greater in this afterglow than in any other source so far observed, afterglow or discharge.

Several times recently I have offered the hypothesis that some of the radiations from the night sky agree closely with observed and predicted Vegard-Kaplan bands. The discovery of this new afterglow spectrum greatly favours that hypothesis. Also in its support is the great increase in relative intensity of the green auroral line when the current in the rapidly interrupted discharge is made equal to the one that produces this new afterglow. The relative intensity of the green line is increased at least by a factor of ten over that reported by me[3] recently in these columns. It is suspected that most of the green line radiation in rapidly interrupted discharges arises in the afterglow, and further experiments are in progress in order to verify this fact.

JOSEPH KAPLAN.

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[1] NATURE, 134, 289, 1934
[2] *Phys Rev*, 45, 671, 1934.
[3] NATURE, 135, 229, Feb 9, 1935.

Electronic Charge from de Broglie Wave-lengths of Electrons

WORK has been going on for some years at Uppsala for the purpose of increasing the accuracy of the determination of electron wave-lengths. A high-tension set has been arranged, with a special electron valve smoothing circuit taking up changes in input and output, and a tension regulating device including a standard cell, so as to give high tension accurately known and steady within 0·01 per cent Cathode rays from a hot filament, accelerated by this tension ($V = 15$–30 kv.) and passing through two narrow slits are diffracted by an etched galena crystal, giving rise to cross-grating diffraction patterns[1]. With this arrangement one gets very sharp spectral lines of different orders. The angles of diffraction can therefore be measured with great accuracy. From these data one can calculate the wave-lengths of the cathode rays with an error less than 0 1 per cent, the grating constant of galena being well known[2].

Using such wave-length values, one can make interesting calculations of several atomic constants. If, for example, we combine de Broglie's equation,

$$\lambda\sqrt{1+\frac{eV}{2m_0c^2}}=\frac{h}{\sqrt{2em_0V}}=\lambda',$$

with the expression for the Rydberg constant,

$$R=\frac{2\pi^2e^4m_0}{ch^3},$$

we obtain for the calculation of the electronic charge

$$e=\text{const.}\,\frac{V^{3/4}\,\lambda'^{3/2}}{\sqrt[4]{e/m_0}}.$$

R is known from spectroscopic measurements with very great accuracy, and e/m_0 is fairly well known and enters the formula in the power 1/4 Thus, we can hope to find e with an accuracy sufficient to enable us to choose between oil drop and X-ray values of e.

Preliminary measurements give $e = (4\cdot796 \pm 0\cdot010) \times 10^{-10}$ E.S.U.

The work is proceeding and a definite and detailed report will shortly be published elsewhere.

S. v. FRIESEN.

Physics Laboratory,
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May 22.

S. v. Friesen, *Arkiv f. Mat Astr. o. Fys.*, 24B, No 8; 1934
E. v. Zeipel, *ibid.*, 25A, No. 8, 1935.

A Search for the Extreme Infra-Red Spectrum of the Sun

THE solar spectrum in the infra-red has been thoroughly investigated throughout the range of wave-lengths up to about 11 μ Radiation of longer wave-length is practically completely absorbed, chiefly by the water vapour present in the atmosphere According to E. von Bahr[1], there are reasons to expect, from theoretical considerations, that for wave-lengths greater than *ca* 400 μ, water vapour will be again transparent. In 1914 Rubens and Schwarzschild[2] made an attempt at the Astrophysical Observatory at Potsdam to measure the intensity of solar radiation in this region of the spectrum by using the quartz lens method for isolating it, but the intensity proved too small to be detected even by means of the very sensitive instrument they used

On the suggestion of Prof M A Lewitsky, we made a similar attempt last summer in the exceptionally clear atmosphere of the southern slopes of Mount Elbruz (Caucasus) at an altitude of 3,000 m. above sea-level. For isolating the extreme infra-red radiation, we used two sheets of black paper placed in front of a metal mirror 60 cm in diameter, this focused the radiation transmitted through the paper on to one group of junctions of a differential surface thermopile, which was used in order to minimise the otherwise very considerable influence of stray radiation and changes of temperature The thermo-current was measured by means of a photo-relay similar in design to that described by Bergmann[3]. For illuminating the differential photo-cell of this relay we used a heliostat

The apparatus proved so sensitive as to enable us to record one tenth of the radiation that was to be expected according to Planck's law for the region beyond 400 μ, that is, the only region of wave-lengths likely to pass through the water vapour of atmosphere, two sheets of black paper and a quartz window, 2 mm. in thickness, of the thermopile

Since the layer of the atmosphere below 3,000 m holds about five-sixths of the total amount of water vapour contained in the atmosphere, we may take it that, so far as the absorption of the sun's rays by water vapour is concerned, the conditions of our experiment were about five times as favourable as those of Rubens and Schwarzschild, who worked at low altitude and in a contaminated atmosphere. On the other hand, the sensitivity of their apparatus was about twice as great as that possible with our apparatus in the open air Although we had thus, on the whole, somewhat better conditions than they, we also were unable to detect any trace of radiation from the sun in the extreme infra-red.

A detailed description of our experiment will be published elsewhere.

V. G. VAFIADI.
S. S. KRIVICH.
G. V. POKROVSKY.

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Leningrad.

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[1] E von Bahr, *Verh. Deutsch Phys Ges.*, 710, 1913
[2] Rubens und Schwarzschild, *Sitzungsberichte Preuss. Akad. Wissensch.*, 702, 1914.
[3] L. Bergmann, *Phys. Z*, 32, 688, 1931

Philosophy and Modern Science

IT is disconcerting to find how rarely physical scientists trouble to make themselves familiar with the results of recent psychological investigation, even those results of the more important and far-reaching kind. While the psychologist is well-nigh constrained to follow, in a general way at least, the progress of physical inquiry, the physicist, when he ventures into the psychological field, almost invariably has recourse to a number of obsolete ideas, ideas which have long since been discarded by psychologists themselves.

What, for example, does Dr. Jeffreys mean by the term "sensation", which he uses so freely in his letter under the above heading in NATURE of June 1? Does he mean the mental act or process of *sensing* (more properly, the mental act or process of perceiving), or does he mean *that which is sensed* (or perceived), what it is now usual to call the *sensum*? If he means the former, then certainly "each sensation is private to one individual"; but, in that case, "we cannot," as Dr. Dingle says, "speak of observing sensations", not at all events in the way Dr. Jeffreys implies, because, as Dr. Dingle puts it, the "sensation" is the observing and "not a thing to be observed". If Dr. Jeffreys means the latter, then no doubt a sensation can be observed, but, in that case, it is sheer dogmatism to assert that sensations "obviously do not exist when they are not observed". That is by no means obvious; on the contrary, I imagine most modern psychologists would agree with Stout that sense-qualities, such as colours and sounds, "do essentially enter into the constitution of the material world". It requires, indeed, but little reflexion to see that what Dr. Dingle calls a "sensation of whiteness" (that is to say, the awareness of whiteness) is not itself white, any more than the apprehension of a triangle is itself triangular.

There is corresponding confusion in the use of the term "concept". It is, of course, impossible here to discuss in detail the nature of concepts; but briefly a concept may, psychologically considered, be said to be a way in which universals are cognised. Clearly, however, neither a ghost nor the planet Neptune (referred to in the correspondence in question) can be said to be either a universal or a concept; each is no less individual and particular than a patch of blue or a sound. Nor is it in the least degree true to say that what are sensations to one person are concepts to another person. I take it that by "concepts" the writer means, in this context, what are usually called "images"; and that he intends to assert that what one person is sensing another person can only imagine. Even that, however, is far from obvious, and cannot be laid down as an indisputable truth.

G. DAWES HICKS.

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June 4.

OTHERS beside Prof. Dingle find this discussion "amusing"[1]. Each disputant is trying to show that only his philosophy is compatible with science; if he succeeded, he would surely destroy the object of his attempt. For the distinctive feature of scientific propositions, and presumably the source of their evidential value, is that they can be believed by anyone, whatever his philosophy.

Of course, this agreement may be illusory. Profs. Dingle and Levy, who have such strong and such divergent views about the "external world", may be assenting to entirely different propositions when they both assent to (say) Ohm's law. But then there is no science for them to quarrel about. If they are assenting to the same proposition, surely their first step should be to find out what this proposition is. Of course, they will never agree as to why they agree; but they might agree as to what they are agreeing about. They will never achieve even that, while they insist in dragging in conceptions, such as reality and existence, that lie at the very core of their differences.

NORMAN R. CAMPBELL.

June 3.

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[1] NATURE, 135, 912, June 1, 1935.

IT does not seem to have occurred to the parties to this controversy that it is based, like so many controversies, on a difference of definition of terms. Prof. Dingle describes the method of science and defines the "logical network" resulting as the "external world". Others might prefer the term "scientific world" or the "scientific picture of the external world". To Prof. Levy the "external world" is what the man of science studies; to Prof. Dingle the result of these studies. So we have words, words, words!

In his letter in NATURE of May 25, Prof. Levy describes two schools of thought, and by so doing implies that they are antithetic. One "claims that science is an historical phenomenon produced by human beings in their handling of the world of which they are parts, a social practice . . ."; the other school sees science "as the organisation of our experiences in logical form". I belong to both these schools and see no inconsistency in doing so. I do not, however, accept Prof. Levy's corollary to his description of his first school that the man of science should be responsible for the social consequences of his work. Were such a doctrine to be acted upon, a scientific laboratory would become an arena for the disputes of ethical teachers and party politicians!

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May 27.

Social Research

THE leading article on "Road Traffic Research" in NATURE of April 13 directs attention once again to the need for scientific research into social problems, for which I contended in my communication in NATURE of December 9 (p. 898). The present very unsatisfactory condition of road traffic is but another instance of Government action in a matter of which those responsible have an inadequate knowledge. As is stated in NATURE of April 13, "The tragic position of the road traffic problem at the moment and the sterility of all attempts to diminish accidents, whether by motor control, registration, insuring, licensing or deterrent enactments, are due primarily to the omission to base legislation on scientific experiments and definite facts. In the absence of such study, well-intentioned legislation is apt to have consequences and repercussions widely different from or even opposed to those for which it was designed".

This passage emphasises the same need with regard to road traffic problems that my communication emphasised with regard to industrial problems generally, the need, that is, that there should be no legislation on industrial problems unless it is based on carefully ascertained facts, and not only facts concerning the industries themselves, but also (what is at least as important) those showing what previous legislation has effected. The fact that there has been more industrial legislation in Great Britain during recent years than ever before in our history, and that our industries, instead of being better, are worse now than before, is in itself a proof that investigation is urgently needed. "The acquisition of data is the first necessity." From the study of these data there must gradually emerge principles of guidance in legislative matters of which we are in sore need: no greater benefit can be conferred by science on humanity at large than the discovery of these principles. It can scarcely be hoped that legislation will be on right lines in the absence of this guidance, which science alone can provide

Let it not be forgotten that our civilisation (of which industry is the main support) has been built up by our forefathers and handed on to us as a precious heritage, and it is our first duty to posterity to see that it does not suffer while under our charge, but is passed on to those who will come after us in a condition somewhat better than that in which we received it; to do less than this we should be guilty of breach of a great trust We are apt to boast of the great advance made by science, but what will be the verdict of the historian of the far future when, in recounting the history of the critical times through which we are now passing, and in view of later disasters, he makes the astonishing discovery that our legislation was framed without scientific guidance of any kind; that while it has occupied itself with the changes and movements taking place in stars and nebulæ millions of light years away, which can affect our civilisation not at all, it neglected those taking place on our doorsteps on which our very existence depended?

ALAN BLAIR.

Meir,
Stoke-on-Trent
May 4

Essential Structural Discontinuities in Certain Adsorbed Films

IN connexion with some recent experimental work, it has been necessary to consider in detail the process of building up an adsorbed film which is formed by the adsorption on neighbouring solid atoms of the two atoms of a diatomic gas molecule, and in which the adsorbed atoms are immobile and stable Such a film is necessarily imperfect and incomplete, having gaps or holes in it.

For the sake of definiteness, let us consider adsorption on a plane in which each surface atom is surrounded by four equally spaced other atoms As the film is gradually built up, certain single surface atoms will find themselves surrounded by four filled places. Such atoms will be able to take no part in the adsorption process and will remain bare. The complete film thus of necessity has a sort of irregular mosaic structure.

It is important to know what proportion of the surface atoms remain bare To do this an experimental numerical test has been carried out in which neighbouring pairs of points on a diagram of such a plane have been selected at random and occupied It was found that about eight per cent of the total number of surface atoms remain uncovered. In order to test whether the particular assumption about the atomic arrangement is of importance, a similar test was carried out on a hexagonal arrangement, so that there could be six possible places for the second atom of a molecule to occupy. The numerical result was practically identical

The actual case under consideration was that of oxygen on tungsten, and experimental evidence for the existence of these gaps has been obtained. The uncovered surface atoms will undoubtedly exert a much greater attraction on impinging oxygen molecules than the other parts of the surface An adsorbed film of molecular oxygen has been found of the right amount to correspond to adsorption on these gaps in the atomic film

For the adsorption of molecular oxygen, these gaps must be regarded as active parts of the surface. They would probably also be centres of catalytic activity if one were using a surface from which the atomic film had not been removed If they were, an amount of oxygen small compared with that required to cover the surface completely would be sufficient to poison it

A full account of experimental methods and their application to the study of these films is ready for publication, together with a discussion of other properties of the gaps.

In conclusion, it may be pointed out that almost any immobile adsorbed film, except one formed by the adsorption of gas molecules on neighbouring surface atoms without dissociation, will have essential irregularities of a similar type

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May 29

Lattice Distortion in Nickel-Iron

RECENT investigations of W. A. Wood[1] on the broadening of high-order Debye-Scherrer lines of copper and α-brass have shown that the lattice distortion may be accompanied by changes in the spacings of various lattice-planes, pointing to a change in shape and (perhaps) size of the unit cell. The occurrence of such an effect can be very clearly shown for nickel-iron For an alloy with 53 atomic per cent Fe, the side-length of the unit-cube a is 3·58 A., so that the (400)-reflections with cobalt $K\alpha_1$ and $K\alpha_2$ radiation occur at about 85° and 87° respectively, and thus show extremely large dispersion (the distance of the α_1 α_2-lines for a specimen to film distance of 12 cm. being about 7 mm.) Back-reflection photographs of discs, cut from recrystallised cold-rolled band, show these reflections with great intensity, as the recrystallisation texture is a very pronounced 'cube-texture' ('Würfellage'), all crystals lying with a cube-face and -side within ± 10° parallel to the plane and direction of rolling[2]. The effect of compression-deformation is shown in Fig. 1,

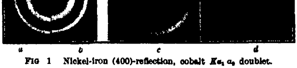

FIG 1 Nickel-iron (400)-reflection, cobalt $K\alpha_1$ α_2 doublet.
a, annealed band
b, after 10 per cent compression perpendicular to plane of rolling
c, „ 2 „ stretching parallel to direction of rolling
d, „ 2 „ „ at 45° „ „ „ „

where *a* relates to the original disc, *b* to the same disc after compressing it to about 10 per cent (the discs were rotated about an axis parallel to the X-ray beam) The shift of the $\alpha_1\alpha_2$-lines amounts to about one sixth of their distance apart, corresponding to a *decrease* in spacing of about 0·04 per cent

Wood observed that the rate of broadening of lines from different planes differed likewise[2]. A directional effect was also observed in our case in the sense that the degree of lattice distortion of a definite plane is dependent on the relative orientation of crystal lattice and direction of deformation; for this experiment, strips of the recrystallised band were stretched by about 2 per cent parallel (Fig 1c) and at 45° (Fig. 1*d*) to the direction of rolling, that is, nearly parallel to a [100]- and a [110]-direction respectively The severe distortion in the second case might perhaps be related to the fact, found for aluminium, that crystals stretched in that direction exhibit an extremely pronounced recrystallisation power[4]

In conclusion, I wish to thank Mr F M. Jacobs for his help in taking the photographs

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[1] W. A Wood, *Phil Mag*, 18, 495, 1934 19, 219, 1935.

[2] W G Burgers and J L Snoek, *Z Metallk*, in press

[3] Compare also G W Brindley and F W Spiers, *Proc Leeds Phil. Soc*, 3, 4, 1934 V Caglioti and G Sachs, *Z Phys*, 74, 647; 1932

[4] W. G. Burgers, *Pap and Disc. Intern Conf Physics*, London, 2, 139, 1934

Lattice Parameters of Solid Solutions in Silver

IN continuation of work on valency effects in alloys, I have recently measured the lattice parameters of the primary solid solutions in silver formed by the elements cadmium, indium, tin and antimony, which follow immediately after silver in the Periodic Table. This work has led to the discovery that in dilute solid-solutions of these elements, the alloys of the same equivalent composition have identical lattice parameters By the term equivalent composition is meant the atomic percentage of the solute element multiplied by its valency, and the above relation implies that if the lattice parameters of the alloys are plotted against the equivalent compositions, the points for all of the four alloy-systems lie on a single curve. Alternatively, it may be said that the initial expansion of the silver lattice produced by one atom of the above elements is proportional to the valency.

The relation is thus of the same type as that previously found for the depression of freezing point of silver by the same elements, and may perhaps indicate an effect proportional to the repulsion between a solute and a solvent ion.

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May 24

Dipole Moments of Ethyl and Phenyl Isocyanates

THE dipole moments[1] and the Raman spectra[2] indicate that the isothiocyanate group, $-N=C=S$, is linear. The isocyanates are now found to resemble the isothiocyanates. The Raman spectra indicate that the group $-N=C=O$ in the isocyanic esters is linear[3], and this conclusion agrees with inferences drawn from the dipole moments.

Ethyl and phenyl isocyanates we find to have moments of 2·81 *D* and 2·28 *D* respectively. No other value for the ethyl compound is available, but the published results for phenyl isocyanate are 2·34 *D* at 18° in benzene[4] and 2·23 *D* at 25° in carbon tetrachloride[5], the mean being 2·28 *D*.

The difference between the moments of the corresponding isothiocyanate and isocyanate gives the value of the excess of the C = S over the C = O moment. This difference deduced from other compounds is given below.

Ethyl isothiocyanate	3·31	0 50	Phenyl isothiocyanate	3 00	0 72
Ethyl isocyanate	2 81		Phenyl isocyanate	2·28	
Thiobenzophenone	3 37	0 42	Dianisyl thioketone	4 44	0 54
Benzophenone	2 95		Dianisyl ketone	3·90	

Bergmann has published two values of the moment of phenyl isothiocyanate, namely[6], 2·76 *D* and[4] 3·00 *D*, and it will be seen that the former value exceeds the moment of phenyl isocyanate by 0 48 *D* The other figures are in satisfactory agreement with each other

The solvent used in the present experiment was benzene, and measurements were at 20°. Ethyl isocyanate, prepared from potassium ethyl sulphate and potassium cyanate, was twice fractionated, dried by sodium sulphate and refractionated. The moment was measured immediately. The physical constants were boiling point, 59·8°/759 mm; d_4^{20} 0·9031, n_D^{20} 1·3808. Phenyl isocyanate from Kahlbaum was dried and fractionated. boiling point, 161·7°/752 mm.; d_4^{20} 1·0946; n_D^{20} 1 5363.

	$P_{2\infty}$	P_E	μ
Ethyl isocyanate	185 c c	18 3 c c.	2 81 *D*
Phenyl isocyanate	144 c c	33 9 c c	2 28 *D*

The details of these results and those for analogous compounds will shortly be published.

J. R. PARTINGTON.
E. G. COWLEY.

Queen Mary College,
University of London.
May 17.

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[1] Hunter and Partington, *J Chem. Soc.*, 2825; 1932.

[2] Langseth, Nielson and Sørensen, *Z phys Chem*, B, 27, 100; 1934

[3] Goubeau, *Ber*, 68, 912, 1935.

[4] Eide and Hassel, *Tids Kjemi*, 10, 93, 1930.

[5] Sidgwick, Sutton and Thomas, *J. Chem Soc.*, 406; 1933.

[6] *Z. phys Chem*, B, 10, 397, 1930

[7] *ibid*, B, 17, 100, 1932.

Interchange of Heavy Atoms in Organo-Metallic Compounds

THE interchange of heavy atoms in organo-metallic compounds, reported by Mrs Leigh-Smith and Dr. Richardson[1], using the radioactive indicator method, is in line with work done by Hilpert and Grüttner[2], who, however, found evidence of detachment of the organic radicals from the metal. They found that a reversible reaction took place between mercury diphenyl and metallic bismuth, with formation of a little diphenyl, at 250° in hydrogen.

When working on alkyl bismuth compounds under the direction of Prof. W J. Jones at Cardiff, I attempted to prepare mixed alkyl-bismuthines, and obtained results indicating some looseness of binding between the bismuth atom and the alkyl residues. On treating amyl bismuth dichloride with ethyl magnesium bromide, triethylbismuthine and tri-*n*-amyl-bismuthine were obtained in addition to *n*-amyl-diethyl-bismuthine. Challenger[3] obtained similar results with ethyl magnesium bromide and diphenyl-bromobismuthine, suggesting that organic radicals are readily liberated from their compounds with bismuth.

Exchange of metal atoms will probably occur with many typical organo-metallic compounds, where the link between carbon and metal is weaker than that between carbon and a non-metal of the same group of the Periodic Table, also, the strength of binding decreases with increasing atomic weight of the central atom.

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May 27

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[1] NATURE, 135, 828, May 18, 1935.
[2] *Ber.*, 46, 1685, 1913
[3] *J Chem Soc*, 105, 2210, 1914

Synthesis of Dehydroandrosterone by the Decomposition of γ-Sitosterol from Soya Beans

Two substances have been isolated from the urine of men which resemble the male hormone in their ability to stimulate the growth of the capon's comb[1]. One of these, androsterone, described in detail by Butenandt and Tscherning[2], has been produced artificially by Ruzicka and his collaborators[3] by means of the oxidative decomposition of epi-dihydro-cholesterol acetate, and has thereby been recognised as 3-epi-oxy-allo-ætio-cholanone-(17). A second oxyketone containing two hydrogen atoms less has been obtained by Butenandt and Dannenbaum[4] from an unsaturated chloroketone, $C_{19}H_{27}OCl$, occurring in extracts of urine, by replacement of the chlorine atom by a hydroxyl group. On carrying out the analogous replacement reaction using the saturated chloroketone, androsterone was obtained. These reactions leave the question unanswered as to the position of the double bond and the steric position of the hydroxyl group.

I have elucidated this by carrying out the synthesis of the hormone by means of the decomposition of one of the known sterols. Acetylated sitosterol obtained from soya beans was chlorinated in the 5,6-position in order to protect the double bond, and the side chain was afterwards removed by vigorous oxidation with chromic acid, more or less according to the classical method of Ruzicka by which the identity of the ring system of sitosterol and cholesterol has been determined[5]. From the dechlorinated and saponified reaction mixture, a sparingly soluble semicarbazone was obtained; this, after hydrolysis, gave beautiful crystals of an oxyketone which proved to be chemically and physiologically identical with dehydroandrosterone obtained from urine in this laboratory. This oxyketone has a melting point at 147°–148° C. (corr.), the mixed melting point with dehydroandrosterone showing no depression, oxime, leaflets or needles, melting point and mixed m.p. 190° C. (corr.); benzoate, melting point 252°–253° C (corr.); specific rotation, + 13·5° in absolute alcohol. The capon unit is about 210γ, which is the same as the dose required of natural dehydroandrosterone (androsterone = 70γ). Dehydroandrosterone is therefore 3-oxy-Δ-5-6-ætiocholenone-(17)

This configuration of the ring system is similar to that of sitosterol and cholesterol, which is interesting in as much as it has been found possible, by a modification of the existing process (K. David[6]) to prepare, in this laboratory, dehydroandrosterone from urine in almost the same quantity as androsterone

The details of this work will be published elsewhere.

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May 17.

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[1] *J Pharm*, 40, 27, 1930
[2] *Z. physiol Chem*, 229, 167, 1934
[3] *Helv Chim Acta*, 17, 1389, 1934
[4] *Z physiol Chem*, 229, 192, 1934
[5] *Helv Chim Acta*, 18, 430, 1935
[6] *Acta brev Neerl*, 5, 1–2, 31, 1935

Selective Accumulation of Lipochrome

IT is well known that different animals deal with carotenoids derived from vegetable sources in various ways. The adipose tissue of the horse and the cow contain considerable amounts of polyene-hydrocarbons (carotenes), but it does not accumulate polyene-alcohols (xanthophylls). A precisely opposite selection would appear to take place in the fat of the hen.

We tried to locate the organ in which this selection takes place and chose the horse for the following experiment. The blood serum of the horse is free from xanthophyll, and therefore the elimination of this carotenoid takes place before it enters the general circulation. So the question arises, whether the polyene-alcohols are not absorbed at all by the gut, or whether they reach the liver and are transformed or eliminated there. To choose between these alternatives, we took blood samples, therefore, while absorption of large amounts of green food was going on, from the portal vein of a narcotised horse. No xanthophyll was found in the serum, the lipochrome of which was identical with that taken from the jugular vein; but the carotene content was found to be increased.

This observation makes it quite probable that xanthophylls do not cross the wall of the gut and that selection already takes place in the digestive organs of the horse.

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E ERNST

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May 18

Keratin Digestion in the Larvæ of the Clothes Moth

THE digestion of keratin in the larvæ of the ordinary clothes moth, *Tineola biselliella*, was investigated by means of the micro-methods developed by Linderstrøm-Lang and Holter. In the secretion of the middle intestine a powerful proteinase was found having a *p*H optimum about 9.3 (40°, splitting up casein) and, contrary to animal trypsin-kinase, being but little sensitive to addition of thiol compounds (sodium sulphide, sodium thioglycolate). The *p*H of the secretion of animals fed with wool was about 10 (measured with the glass electrode in a carbon dioxide free chamber) and gave a strong nitroprusside reaction which was most clearly visible in the half-digested hairs present as contamination in the secretion. The reaction disappeared soon after the secretion had been exposed to the air; only a very small further visible change of the hairs was observable when the secretion (with half-digested hairs) was kept in a moist chamber after removal from the intestine. Animals fed with cotton wool or filter-paper (made inviting to the animal by covering it with a thin film of casein and wool-fat) gave scarcely any nitroprusside reaction, but the reaction reappeared when cystin was added to this food (although this is left quite undigested by the animal).

It was therefore assumed that the secretion contains an agent capable of reducing the S − S bonds in the hair (see Astbury[1] and Speakman[2], Goddard and Michaelis[3]) but auto-oxidisable in the air The reduction of the hair keratin opens its peptide chains to the attack of the proteinase (Goddard and Michaelis) the activity of which is but little influenced by the low oxidation-reduction potential of the medium The nature of the reducing agent is unknown It is not a thiol compound Its reducing power may be estimated from the accompanying table, which records some experiments on the reduction of certain dyes in the middle intestine (see also Titschack[4]).

Dye	E_h at pH 10	Animals fed with wool stained with dyes SH + (Reducing agent having reacted with S − S)	Animals fed with cotton wool stained with dyes SH − ("Pure reducing agent")
Methylene blue	− 0·08	reduced	reduced
Indigo tetrasulphonate	− 0·13	,,	,,
Indigo disulphonate	− 0·22	partly reduced	partly reduced
Gallophenine	− 0·29	,,	,,
Brilliant alizarine blue	− 0·34	not reduced	not reduced
Rosinduline GG	− 0·44	,,	,,

Experiments on the digestion of sheep wool by the moth proteinase *in vitro* using sodium thioglycolate as reducing agent at pH 10 (Goddard, Michaelis) showed a rapid splitting-up of the wool with formation of equivalent quantities of amino and carboxylic groups Under the same conditions pancreatic trypsin-kinase with the same activity towards casein had no effect, due to inhibition by the thiol compounds

The experiments are being continued

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May 23.

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[1] W T Astbury, *Trans Faraday Soc*, **29**, 103, 1933

[2] J. B Speakman and Hirst, M C, *Trans Faraday Soc*, **29**, 148, 1933.

[3] D R Goddard and L Michaelis, *J Biol Chem*, **106**, 605, 1934

[4] E Titschack, *Z tech Biol*, **10**, 92, 1922

Mechanism of Respiration

IN a previous letter[1], I discussed the respiration of the minced breast muscle of the pigeon In this material succinic acid seems to play by its reversible two-step oxidation to fumaric and hydroxyfumaric acid an important rôle as catalytic hydrogen carrier.

Dr. K. A. C. Elliott[2] ascribes my results to a simple methodic error, and doubts the possibility of generalisation. Owing to the nature and bulk of evidence, discussion is impossible within the limits of these columns. I must refer to the complete paper which I hope to publish soon. Our recent experiments confirm our previous results and show that at any rate a limited generalisation is warranted. Of the two steps of oxidation: succinic to fumaric acid and fumaric to hydroxyfumaric acid, the latter is quantitatively the more important. Malic acid is not activated. The apparent activation of this substance is due to the presence of fumarase. This might explain Elliott's results.

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May 15.

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[1] NATURE, **135**, 305, Feb 23, 1935.

[2] NATURE, **135**, 762, May 4, 1935

Giant Cells in Insects Parasitised by Hymenopterous Larvæ

IN a recent paper, A Paillot[1] directs attention to the giant cells present in aphids parasitised by Hymenoptera, and he affirms that these cells originate from the sexual cells of the host. In support of this conclusion, Paillot states that he has once observed in a female of *Chaitophorus aceris*, parasitised by *Aphidius ribis*, Hal a group of cells (considered by him to be germinal cells) in process of dispersion, and that these elements already showed the structure of giant cells

Giant cells, appearing as opaque white globules of various sizes, are invariably present in weevils of *Sitona lineata*, L, containing immature larvæ of the braconid, *Dinocampus* (*Perilitus*) *rutilus*, Nees Investigation[2,3] has shown that these cells are the hypertrophied cells of the embryonic membrane of the parasite egg When the larva emerges from the chorion, the cells of the embryonic membrane dissociate and become free in the body cavity of the host. They then increase greatly in size, absorbing fatty matter from the body fluid. They constitute the principal food of the larva in its later stages It was found that these cells continued their development even should the parasite larva die young, and they may then attain an abnormally large size. This point is of interest in view of Paillot's statement that he has found giant cells present in aphids without a developing parasite larva, and in such cases he considered that the parasite embryo had been completely reabsorbed.

Dissociation of the cells of the embryonic membrane, either singly or in groups, and their persistence during parasitism, has been observed in various parasitic Hymenoptera, and the literature on this subject has already been discussed[3] Since then, a paper by Oglobin[4] has come to my notice, in which he gives a detailed description of the origin and development of the giant cells in *Dinocampus terminatus*, and his account agrees in all essentials with my observations on *D rutilus* Further contributions to this subject are to be found in Parker's studies of *Macrocentrus gifuensis*, Ashmead[5], and *Meteorus nigricollis*, Thomson[6]. In the Aphidiini, Spencer[7] has found that the serosa breaks up into pieces when the larva hatches. The serosal fragments become rounded off and increase in size. They are afterwards eaten by the larva. I have no doubt that these serosal fragments constitute the "giant cells" observed by Paillot.

In an earlier paper[8], Paillot comments on the giant cells found in caterpillars of *Pieris brassicæ*, and he considers that they originate from the ordinary elements of the blood of the host. He suggests that the influence inducing the hypertrophy of these cells may be connected with the presence of the larvæ of *Apanteles* Fauré[9] has found that the presence of giant cells in the blood of caterpillars of *P brassicæ* is a sure indication of parasitism by *Apanteles* larvæ. Grandori[10] has described how in *A glomeratus* the cells of the embryonic membrane dissociate when the larva hatches, and he states that these cells preserve their vitality to the end of the larval life It is therefore highly probable that, in this case also, the giant cells referred to by Paillot are derived from the embryonic membrane of the parasite.

It is not yet known in how many groups of parasitic Hymenoptera dissociation of the embryonic membrane and later hypertrophy of the cells occur, and it is probable that in many forms no such phenomena take place. Chrystal[11] observed that, in the cynipoid, *Ibalia leucospoides*, Hochenw , no dissociation of the trophamnion occurred, and in the ichneumon, *Pimpla examinator*, F , I have been unable to find either a cellular membrane or dissociated cells in the egg at the time of hatching, though at an earlier stage the embryonic membrane is distinct.

DOROTHY J JACKSON

North Cliff,
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June 5

[1] *C R Acad Sci*, **199** 1450, 1934

[2] NATURE, **118**, 353 1924

[3] *Proc Zool Soc*, 597, 1928

[4] *Pub Inst Zool Univ Charles, Prague* **5**, 1, 1924

[5] *Tech Bull, U S Dept Agric*, **230** 1931

[6] *Proc. Ent Soc Wash*, **33**, 93, 1931

[7] *Ann Ent Soc Amer*, **15**, 119, 1922

[8] *C R Soc biol*, **81**, 187, 1918

[9] "Contribution à l'Etude d'un Complexe biologique La Piéride du Chou (*Pieris brassicæ*, L) et ses parasites Hyménoptères" Lyon, 1926

[10] *Redia*, Florence, 7, 363, 1911

[11] *Oxford Forestry Memoir*, **11**, 1930

The Breeding of a Grey Mullet, *Mugil capito*, Cuv., in Lake Qarun, Egypt

THE common grey mullets of Egypt, *M cephalus* (Linn.) and *M capito*, Cuv , feed and grow in the delta lakes and are presumed to spawn near the sea coast.

Lake Qarun lies some two hundred kilometres south of the Mediterranean coast The salinity is increasing and the gradient between fresh and salt in the water is such as to resemble the delta habitats of the mullets.

In the autumn of 1928 one of us succeeded in introducing to this lake 20,000 live fry, chiefly of *M cephalus*, the larger of the two species As these fry grew up but did not give rise to any second generation, continuous stocking was resorted to from 1932 onwards, with results that are shown in tabular form below ·

Year	Date of fry transfer	Number of fry introduced	Mullet landings in kgm *M. cephalus* 1929–31, *M cephalus* and *M capito* after	Salinity 1 km. east of Quallieh Island in parts per 1000
1928	Sept -Dec	20,000	——	17 19
1929	——	——	181	17 34
1930	——	——	427	17 30
1931	——	——	52	20·00
1932	16 11 31 to 10 1 32	154,000	1,154	22 40
1933	12 11 32 to 9 1 33	136,080	2,792	21·29
1934	2 12 33 to 11 2 34	257,460	42,275	18·19
1935	2 12 34 to 4 3 35	258,600	132,060 (Jan.–March)	——

Up to 1933 the weight of mullet taken from the lake bore a rough proportion to the fry introduced, but since 1934 there has been a progression of the catch (chiefly *M. capito*) that could only have been due to natural reproduction, and is out of all proportion to the fry introduced Moreover, in a tow-net sample collected on October 24, 1934, several stages of developing eggs and larvæ were found These can only be referred to *M capito*, and represent the first definite identification of these stages of the species A description will shortly be published elsewhere

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Human Remains from Kanam and Kanjera, Kenya Colony

IT was with much regret that I learned that space could not be found for my reply to Prof P G H Boswell's letter in NATURE of March 9 (p. 371) about the human remains at Kanam and Kanjera Many readers of NATURE will doubtless have wondered why no comment has appeared over my signature. I would be grateful if now you would insert this brief note, and the whole matter can then be left for full discussion on my return to England at the close of my present Expedition.

L S B LEAKEY.

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May 28

[DR LEAKEY's reply to Prof. Boswell's letter would have occupied several columns of NATURE, and space could not possibly be found for it The suggestion was, therefore, made to Dr Leakey that he should send a short reply to the specific points stated by Prof Boswell and deal with them in detail in a communication to a scientific society EDITOR, NATURE]

Polyphyletic Origin of Metazoa from Plants

BOTANISTS show us an aspect of evolution-in-progress, so far as that *can* be shown, of which zoologists tell us nothing—because there is possibly nothing to tell The evolution of plants is often indicated in terms of the appearance of the sexual differentiation in unicellular organisms, of the appearance of multicellularity, of the total life-cycle of one plant as an alternation of two generations, asexual and sexual, the individuals being sometimes morphologically distinct and independent, and of the various fate of these phases of the total life cycle in, say, the moss, the fern and the angiosperm, when they are not distinct and independent individuals, "but the one remains permanently connected to the other like a parasite on its host plant" in Strasburger's words.

This aspect of evolution applies just as much to animals as to plants , the vertebrate, like the angiosperm, is an integration of two phases of a life-cycle, the sexual phase being greatly reduced ; and other metazoan phyla exhibit other modes of development of the life cycle. But they do not exhibit the development 'in progress', so to speak, each exhibits a particular mode established. There is as great a diversity among animals as among plants as to what constitutes what may be called the individual, and there is no trace at all of the development of such diverse types of individual—in *animal* evolution.

At the same time there is a conspicuous lack of plausible genetic affinities among the animal phyla. Zoologists make half hearted suggestions as to phyletic affinities and with more heart indulge themselves in the construction of hypothetical ancestral forms for the different phyla. But once the possibility is entertained of deriving metazoan phyla from the less specialised multicellular plants, it is easy to see why Echinoderms, especially the extinct Crinoids, are such paradoxical animals, *Hydra viridis* and *Convoluta roscoffensis* are no longer dubious cases of symbiosis but animals which retain something of the character of their plant ancestors, vertebrates may be traced back, through the tail of the larval Ascidian and the Tunicates with no tailed larva stage in their development, to perhaps a red alga, and there may be more than a jingling verbal relationship between Bryophyta and Bryozoa.

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Points from Foregoing Letters

PROF. J. W. McBAIN considers the association of molecules as the characteristic factor in colloids, and raises the question how far it is effective in the case of long chain molecules. He states that in concentrated solutions of simple sulphonic acid, molecular association, rather than inter-ionic attraction, is responsible for the increase in conductivity, freezing point lowering, etc.

The Raman spectra of benzenes containing heavy hydrogen (C_6D_6 and C_6H_5D) are described by a group of seven investigators from University College, London, and are compared with observations by Klit and Langseth. The evidence, it is stated, permits the view that the benzene molecule has a plain regular hexagonal structure (D_{6h} symmetry).

Prof. J. Kaplan submits an afterglow spectrogram obtained by passing a current of low density through nitrogen. It shows a great enhancement of the relative intensity of the Vegard-Kaplan bands which, the author maintains, agree closely with the radiations from the night sky. With a rapidly interrupted discharge and low current the relative intensity of the green auroral line is also greatly increased, suggesting that it may arise in the afterglow.

A new method of calculating the charge of an electron from the electronic diffraction produced by crystals, has been devised by S. v. Friesen (by combining de Broglie's equation with the formula for the Rydberg constant). Preliminary measurements give a value of $4 \cdot 796 \times 10^{-10}$ E.S.U., as compared with $4 \cdot 77 \times 10^{-10}$ by the oil drop method and $4 \cdot 80 \times 10^{-10}$ from X-ray diffraction measurements.

A communication from the Optical Institute, Leningrad, states that experiments carried out in the exceptionally clear atmosphere of the southern slopes of Mount Elbruz (Caucasus) with the view of detecting solar infra-red radiation of wave-lengths longer than 11 μ have given negative results.

Dr. J. K. Roberts discusses the adsorption of diatomic gas molecules on solid surfaces, and concludes that the resulting adsorbed films are not continuous. Certain single surface atoms remain bare and may afterwards show catalytic activity.

X-ray diffraction photographs of a nickel-iron alloy distorted by cold working are submitted by Dr. W. G. Burgers. They show that compression and stretching change the shape and perhaps the size of the lattice-spacing.

The addition of cadmium, indium, tin and antimony to silver, changes its lattice structure and depresses the freezing point by an amount proportional to the valency of the added element, according to W. Hume-Rothery.

The dipole moments of ethyl and phenyl isocyanates have been determined by Prof. J. R. Partington and E. G. Cowley. From the values obtained, they infer that the $-N=C=O$ group in these compounds is linear, as is also indicated by the Raman spectra of the light they scatter.

I. Norvick mentions a reaction between alkyl-organic compounds of bismuth and of magnesium in which, as in the case recently described by Mrs. Leigh-Smith and Dr. Richardson, bismuth atoms were apparently able to wander from one organic radicle to another.

Starting with sitosterol, a constituent of soya beans, R. V. Oppenauer has synthesised one of the male sex hormones (dehydroandrosterone), thus elucidating its structure, which was hitherto incompletely known.

The horse and cow store carotenes in their fatty tissues, while the hen stores the closely related xanthophylls, all of which are derived from vegetable sources. Messrs. L. Zechmeister, P. Tuzson and E. Ernst find that, after feeding on green food, the blood serum of the horse shows an increase of carotenes and no xanthophylls. Hence the selection appears to take place in the digestive organs.

According to K. Linderstrøm-Lang and F. Duspiva, the clothes moth, *Tineola bisselliella*, digests wool keratin by means of an enzyme active in alkaline medium (pH 9.3), after the keratin has been chemically reduced by an agent as yet unknown.

Giant cells found in weevils of *Sitona lineata* and other insects parasitised by hymenopterous larvæ are derived, Miss Dorothy J. Jackson states, from the embryonic membrane of the larvæ, which become dissociated when the larvæ emerge from the chorion, they do not arise from the host's cells, as suggested by Paillot in the case of *Chaitophorus aceris* and in caterpillars of *Pieris brassicæ*.

ERRATUM. It was stated in the summary of a letter in the issue of June 8, that an external magnetic field *increases* the resistance of nickel-iron wires at audio-frequencies. Actually, as the letter indicated, the application of an external field *decreases* the resistance.

Research Items

Romano-British Potters' Stamps. Students of Romano British antiquities will welcome a further list of potters' stamps on *terra sigillata* from Gloucester, which has been published by Mr Charles Green, curator of the Public Museum (Occasional Papers No. 2, Public Museum, Gloucester, pp 12, 6*d*) The examples included in this second list are part of the results of extensive excavations which were carried out early in 1934 in King's Square, Gloucester The trenches pierced the north-east angle of the wall of Glevum and for some distance ran parallel to the east wall More than forty of a large number of potters' stamps proved to be legible, and form the basis of this catalogue, but a few recently discovered stamps from other parts of the city are included Fifteen of the stamps may antedate the foundation of the *colonia* of Glevum, the remainder are of the second century A D The majority of the stamps belong to various potters of Lezoux, a number come from La Gaufresenque, and two from Rheinzabern A detailed study of the Romano-British pottery which has been found in Gloucester is now in course of preparation

Natives of Angola Although the Portuguese have been established in Angola for more than four centuries, it is only recently that this vast territory of 1,200,000 square kilometres has been penetrated completely and subdued Its pacification is now so complete that M. Christian de Caters has traversed it in all directions, from frontier to frontier, without arms (*La Nature*, May 15) The natives are estimated to number between four and five millions, nearly all of Bantu race, though there are a few scattered tribes of Bushmen, leading a miserable existence, in the centre The Bantu, however, are divided into an extraordinarily large number of branches On the coast the natives have entirely lost their indigenous culture. In the north-west the Fiot or Congo, who extend from the Cabinda enclave to the neighbourhood of Loanda, have lost their culture near the railway, but in the remoter parts, although they preserve the record of their contact with civilisation in their houses, which are of European form, in which the walls are decorated with drawings of locomotives, steamboats and other like objects, they have abandoned European dress Farther east is one of the most interesting of the groups in Angola, the Lundas. Inhabiting a country which is sparsely wooded or savannah, they live by hunting with bow and lances of a peculiar and interesting form A characteristic weapon is a club in the form of a human head Some of these are negroid, others of a refined type recalling Egyptian or primitive Greek characters. Their fondness for dancing and fear of fetish are marked. Their musical instrument is the marimba or xylophone. Fear of fetish places them at the mercy of sorcerers, who are not slow to profit thereby. They are particularly skilled in the use of poisons. Generally the Lunda wear no clothes The women dress their hair with a mixture of oil and red ochre. Sometimes they wear a species of cap in brick-red and the whole of the body may be covered with a red powder.

Body Fluids of Aquatic Animals. In his presidential address before the Linnean Society of New South Wales, at its annual general meeting on March 27, Prof. W J Dakin gave an account of the relation between the osmotic pressure and the salt contents of the blood and body fluids of aquatic animals to the constitution of the external medium After touching upon the early history of the subject he dealt with his own early work, and showed how at first it seemed as if all the aquatic invertebrates were to be regarded as highly dependent upon the constitution of the water bathing their bodies, whereas the fishes and all the animals above them (reptiles, amphibia, birds and mammals) had evolved an independence which was most striking in the aquatic groups of the fishes The fact that the bounding membranes of all these animals can be shown to be permeable to water and probably to salts makes the search for the controlling mechanism one of the fundamental problems in biology Prof Dakin discussed the possible origin of the independence so characteristic of vertebrate blood and disagreed with the theories of Macallum that the salinity of vertebrate blood represented that of a primeval ocean in which the provertebrates had evolved He showed that it was possible for an aquatic invertebrate to sustain a similar independence in fresh water, and that it was quite likely that the early aquatic vertebrates had evolved their independence in fresh water. On the other hand, the salt contents of living cells as well as of body fluids might well be a relic of the origin of life in water

Breeding of a Japanese Fresh-water Bivalve. K. Okada (*Sci Rep Tôhoku Imp Univ*, 9, No 4, 1935) has studied the nutrition of the embryos of *Musculium heterodon*, a Japanese fresh-water mollusc allied to the British fresh-water bivalve, *Sphærium corneum* When the fertilised eggs come into the interspaces between the interlamellar junctions of the inner gill, the walls of adjacent junctions are eroded and thus a cavity is formed the wall of which thickens, apparently by the addition of blood corpuscles, and thus the marsupial sac is formed Its wall is single-layered and envelops eggs which are in cleavage Three or four such sacs fuse and form a larger sac, the wall of which becomes two layered and contains embryos beyond the gastrula stage This sac becomes still larger and displaced more dorsally and the embryos remain in it until they attain the form of the adult and are about 2 mm long The outer layer of the sac is the original single wall, the inner layer originates from blood corpuscles which have migrated into the sac from the hæmocœl, and the young mollusc is nourished at the expense of these blood cells of the parent

Insects Collected by the Kalahari Expedition. Certain of the scientific results of the Vernay Lang Kalahari Expedition, 1930, are reported upon in the *Annals of the Transvaal Museum*, 16, Part 4, Feb. 1935 The collecting of specimens took place between the months March and September and, since this period was at the close of the rainy season, the material obtained was not so abundant as might have been expected had the work taken place earlier The Sphegidæ and Psammocharidæ are dealt with by Dr. G. Arnold, who describes five new species and one new variety belonging to the first mentioned family and two new species of Psammocharidæ. In Dr. A. J. Hesse's account of the Mutillid wasps, he records 11 genera and 31 species of the family, of which 8 species were previously undescribed, together with several minor forms. This same authority is also responsible for working out the beetles of the family Tenebrionidæ—a group represented by more than 2,300 specimens. This extensive collection, although exceedingly rich in numbers, is comparatively poor in genera and species which were obtained by the expedition on their journey through the extensive region of Nganiland and northern Bechuanaland. It is, however, of special interest, since no material has been hitherto available from the Kalahari Desert. Out of 114 species obtained, 16 are described for the first time. The other reports in the present contribution deal with the Heteroptera, the blood-sucking Diptera and the Trypetidæ.

Bird Malaria. K. S. Shah (*Amer. J. Hyg.*, **19**, 392–403; 1934), in view of the deficient information and divergent views on the incidence and development of gametocytes (crescents) in human malignant malaria (*Plasmodium falciparum*), has investigated birds infected with the malaria parasite *Plasmodium cathemerium*, which resembles in morphology and life cycle the species *falciparum*. He states that when the canary is infected with *P. cathemerium*, gametocytes appeared in the peripheral circulation early in the infection and in the majority of cases simultaneously with the asexual forms. The number of gametocytes increased with the increase in asexual forms and the incidence was highest at the peak of infection; the number of gametocytes diminished with the fall of the infection. In a later paper in the same journal (pp. 502–507; 1934) Shah, Rozeboom and del Rosario record that gametocytes were present in sufficient numbers in the peripheral blood, during the early period of patency, to infect mosquitoes (*Culex pipiens*), that the chances of mosquitoes becoming infected were greater when they were allowed to feed at night than during the day, and that when canaries were experimentally infected with sporozoites the gametocytes appeared in the peripheral blood early in the infection and in most cases simultaneously with the asexual forms.

Eelgrass in the Atlantic. Many interesting problems were presented to biologists and to all interested in problems connected with the Atlantic coast-line, by the rapid diminution, reported from both the American and European sides of the Atlantic Ocean during 1931 and 1932, of the eelgrass (*Zostera marina*), which grows on mud shores, at levels where it is usually submerged by the sea. The plant is widespread and ordinarily grows in dense mats on the mud flats of bays and estuaries, and as its disappearance was often extremely rapid so that 99 per cent of the original vegetation disappeared within one season, the phenomenon was exceedingly striking and aroused widespread attention. A very interesting summary by Clarence Cottam, of the data accumulated as a result, is issued by the United States Department of Agriculture, as *Wildlife Research and Management Leaflet*, BS-3, February 1935. Many causes have been suggested for the widespread disappearance of the plant, which has not been associated with any similar disappearance of the species of *Zostera* fringing the Pacific coast-lines. Several parasitic causes have been suggested (see NATURE, **134**, 416; 1934), and these are briefly reviewed and the complexity of the problem stressed. Eelgrass has many direct commercial uses in different countries, as an insulator, as a packing material, in upholstering, etc., but its main biological importance is as a food or as a sheltering habitat for the natural food of many waterfowl. The effect of its general disappearance is closely examined. It normally forms more than 80 per cent of the food of the sea brant, and there is evidence that the numbers of this species on the coast of North Carolina were very seriously reduced (down to 2 per cent) in the winter of 1934–35 as compared with 1929–30. Fortunately, in other areas the reduction has not been so severe. The writer points out that there is evidence that previous periods of scarcity of eelgrass have been experienced on the Atlantic seaboard, and he finds some evidence for a recovery of the plant in certain areas, both on the American and European coasts.

Water Mould Fungi. A paper by Miss Evelyn J. Forbes (*Trans. Brit. Mycol. Soc.*, **19**, Part 3, 221–239, February 1935) reports a study of water fungi, using methods recommended by American workers. Samples of water are 'baited' with sterilised hemp seed, which induces the fungi to grow. Cultures are purified by teasing out hyphæ under a binocular microscope and removing pieces bearing spores to plates of malt agar or corn meal agar. Samples of natural waters from the Bristol district yielded twenty-two species of aquatic fungi, fourteen of which are new to Britain. The new records include ten species of the genus *Achyla*, two of *Rhipidium*, one of *Calyptralegnia*, and one of *Brevilegnia*. The species are described in detail, and three plates further enrich their characters.

Microseisms at Kew. In a recent memoir (*Meteorological Office Geoph. Mem.*, No. 66, 1935), Mr. A. W. Lee continues his interesting studies on microseismic disturbances recorded by the Galitzin seismograph at Kew. The north–south, east–west and vertical components of the microseisms have been tabulated for four hours daily throughout the year 1932. The mean amplitudes and periods for the whole year of the three components are approximately equal ($0·9\mu$ and 5·6 sec.). The amplitudes of the two horizontal components are nearly equal for all periods, but the ratio of the horizontal to the vertical amplitudes decreases from about 1·2 for microseisms of period 4½ sec. to 0·85 for those of period 9 sec., a variation that is consistent with the hypothesis that the microseisms may be regarded as Rayleigh waves through granite covered by a superficial layer. The vertical component is more trustworthy than either of the horizontal components for the measurement of microseisms, as there are no uncertainties due to changes in the direction in which the waves travel, and it is less affected by the local geological structure. Since the beginning of the present year, it has therefore been used for the tabulation of microseisms at Kew Observatory.

Snow Crystals Observed in Japan. In the *Journal of the Faculty of Science* of Hokkaido Imperial University, Sapporo (Physics, Dec. 1934), there are two interesting papers on snow crystals. The first paper, by U. Nakaya and K. Hasikura, describes 250 photographs of snow and frost crystals they obtained at a sheltered cottage half way up Mount Tokati at an altitude of about 3,400 ft. The spot was protected from strong winds and very favourable to the formation of large and perfect crystals, the temperature being nearly constant at −10° C. At this temperature, it was possible to separate some of the crystals into their components and to cut others so as to get good photomicrographs. Some novel shapes were obtained. At Sapporo it was relatively warm and humid, and crystals with water droplets were frequently observed. All the types obtained are classified and ninety-eight large photographs are given showing minute details. The second paper, by V. Nakaya and T. Terada, discusses the electrical nature of snow particles. The authors use an electric deflexion method of measuring the charge. The frequency of occurrence of negatively charged snow was the more common. Sometimes 90 per cent of the crystals were negatively charged. When the crystals had attached water droplets the positive particles tended to be more frequently observed. They were unable to verify when a large snowflake split by mutual friction into large and small portions that the large parts were positively electrified and the small ones negatively electrified. They intend continuing similar measurements on various types of snow crystals next winter.

Electrical Analysis of Human Language. Vol. 18, Nos. 3 and 4 of the publications of the Psychological Institute of the University of Milan reports an interesting investigation into the function of human language by means of an electrical analysis, by A. Gemelli and C. Pastori. By electrical apparatus, the oscillographic curves of words and sentences can be recorded, and the writers claim that the laws governing sensory perception and movement are equally applicable to language. Language is a sequence of sound organisations each of which is, by itself, a more or less constant whole. Each word is shown by oscillographic curves to be a whole consisting of different sounds. These sound elements can be investigated separately, but they derive their meaning from the whole of which they are parts, and in turn influence the whole. The same holds for the sentence as a whole. It is also a unit and at the same time a system of words and movements. Various factors influence these movements, and of these melody seems to be particularly important as a means of unifying and totalising. To these unified and organised movements that build up language there are corresponding organisations on the perceptual side: in this way meaning enters and makes understanding of language possible.

Recombination of Hydrogen and Deuterium Atoms. Many investigations have been made of the mechanism of recombination of hydrogen atoms with the object of specifying the efficiencies of the third bodies necessary in collisions producing molecules. I. Amdur (*J. Amer. Chem. Soc.*, **57**, 856; 1935) has made experiments in which hydrogen or deuterium is dissociated in a Wood discharge tube, and the mixture of atoms and molecules is pumped along a recombination tube with the walls covered with phosphoric acid. Atom concentrations were measured by means of a small platinum catalyst calorimeter which could be lowered to various positions in the tube. In agreement with results of Smallwood, the recombination of atomic hydrogen was found to proceed homogeneously as the result of triple collisions involving atoms rather than molecules as third bodies, so that the rate equation becomes $-d[\mathrm{H}]/dt = k[\mathrm{H}]^3$. An analogous equation holds for deuterium. The values of k for H and D are $2{\cdot}05 \times 10^{16}$ and $1{\cdot}51 \times 10^{16}$, the ratio being $1{\cdot}36 \pm 0{\cdot}06$. If the diameters and interatomic forces are assumed to be the same for hydrogen and deuterium atoms, the theoretical ratio is 1·41 (that is, $\sqrt{2}/1$). The approximate agreement indicates that the diameters and forces are equal. Viscosity measurements have shown a similar equality of *molecular* diameters and forces for H_2 and D_2.

Theory of Groups. Four recent numbers (194, 195, 198, 205) of the series "Actualités Scientifiques et Industrielles" (Paris: Hermann et Cie., 1935) deal with various aspects of the theory of groups. H. Cartan's "Sur les groupes de transformations analytiques" and E. Cartan's "La méthode du repère mobile, la théorie des groupes continus et les espaces généralisés" deal with Lie's theory, the first from the analytical aspect, the second from the geometrical, using the familiar notion of moving axes. These two pamphlets are written so as to make them intelligible to non-specialists. The other two are on the algebraical side, and make heavier demands on the reader. R. Baer's "Automorphismen von Erweiterungsgruppen" is closely connected with the work of A. Speiser and I. Schur. R. Brauer's "Über die Darstellungen von Gruppen in Galoisschen Feldern" is a continuation of the work of G. Frobenius and L. E. Dickson.

Airway and Aerodrome Lighting. The technique of aviation lighting has now reached an interesting stage. Further progress depends on attaining a clearer understanding of what the lights should do and the best way of arranging them. At a joint meeting of the Illuminating Engineering Society and the Royal Aeronautical Society held on March 12, Mr. H. N. Green described some recent developments. A light is said to be 'visible' when the illumination it produces on the eye exceeds a certain minimum known as the threshold illumination. Experiments prove that a light of 0·5 candle power at a distance of one mile can be located without undue difficulty or delay by observers wearing goggles and subjected to local lighting equivalent to that in an aeroplane cockpit. It is known that white light can be recognised more easily when looking slightly away from it; the threshold illumination for 'parafoveal' vision being only one fifth of that necessary when it is viewed directly. A light seen obliquely can be identified when its conspicuity is of the order of 0·1 mile candle. The practical value is taken as 0·5 mile candle. The most important lights are the beacon lights which are placed near the airway to indicate the route. It has been noticed that powerful lights at long range are easier to see in bad weather than lights of less intensity at shorter ranges. The time taken to locate a flashing beacon is partially dependent on the period elapsing between flashes. Experience has led to the use of periods not exceeding five seconds. The beacons required to locate the aerodrome are built up of neon tubes giving 4,000 candles of red light. To identify the aerodrome they flash a Morse signal. This is necessary as the exterior neon lighting of cinemas often exceeds that of a neon beacon. The boundary lights are not yet standardised internationally, but the aerodrome obstruction lights are always fixed and of a red colour.

Prehistory of Northern Africa

AN important study of the archæology and racial history of the western area of North Africa, published by the Institut de Paléontologie humaine,[*] arises out of the investigation by M. C. Arambourg in the years 1927–30 of a series of caves in the hills which fringe the Gulf of Bougie on the coast of Algeria. Several of these caves were already known to archæologists and palæontologists, and finds in them have been described from time to time, but no systematic investigation had been undertaken previously.

The cave of Afalou-bou-Rhummel is a large shelter of ten metres in depth with an opening about twenty metres wide. Its deposits were first examined by trenching along the axis of the cave to a depth of 9.15 m. over a length of 17 metres. The ossuary was found at a depth of between 3.25 m. and 4 m. at about three metres from the south wall. Eight complete skeletons and about fifty skulls were recovered. Another complete skeleton, with the cranium of a child, was found later at a lower level.

The deposits of the cave fall into two sections of which the upper only, reaching to a depth of 7.50 m., contained evidence of human occupation. The lower, archæologically and palæontologically sterile, reaches bed rock through a depth of 8 metres.

The upper stratum of the archæological level to a depth of 4·40 m. contains a uniform industry, of which the chief characteristic is a microlith *à dos retaillé* of the 'La Mouillah' type. The food debris consist almost entirely of marine shells. Below is a deposit 1 metre in thickness in which there is no variation in the industry, but the deposits are of a reddish yellow in colour and the debris of food include some bones of the moufflon in addition to the marine shells. Below this is a sterile layer of 50 cm. thickness which overlies the third archæological layer of reddish thickly compacted deposits 1.8 m. thick, in which the animal remains constitute a veritable bone bed. Not only was the food-supply of the inhabitants of this period more varied than that of their successors, but also their stone industry, though essentially identical, was more abundant. Below this the sterile layers begin.

The human remains were found in a state of confusion and many of the bones were calcined. The industry of the archæological levels consists almost exclusively of flint and polished bone-blades, flakes and scrapers. It is virtually identical throughout except that in the upper and later levels there is an increase in the percentage of microliths. Among the molluscs which served as food, *Patella*, *Trochus* and *Helix* are very common, and among the mammalia the dorcas gazelle, moufflon and *Bos primigenius* are frequent.

In the rock-shelter of Tamar-hat, which is now about six metres broad by eight metres deep, but once was much larger, trenching revealed an uninterrupted succession of archæological deposits of more than five metres depth. Here, also, through a succession of five distinguishable levels, there was what is essentially an identity of industry—again with a predominance in the later stages of the small blades. The vertebrates and mollusca appear in the same relation as at Afalou, but *Hippotragus* appears here for the first time in North Africa.

Taking into account certain positive and negative characters, M. Arambourg arrives at the conclusion that the industry from the two cave sites is typically Ibero-Maurusian and comparable with that industry as identified on other sites in North Africa in a distribution extending from Morocco to Tunis. As a result of an analysis of the upper palæolithic stone age of North Africa, he also concludes that the Ibero-Maurusian industry, lying between Mousterian and Maurotanian neolithic, is to be considered as a facies of the Upper Palæolithic, parallel to the Capsian facies, of which it takes the place on the littoral of Constantine, in Oran, Algeria and Morocco. This view is corroborated by the identification of Capsian man and Ibero-Maurusian man, now made possible by the discovery of skeletal remains in the cave of Afalou.

M. Arambourg goes on to wider inference that a similar interpretation is to be placed upon the succession of specialised industries of the Upper Palæolithic elsewhere, as, for example, in Kenya and South Africa. These, as the Capsian and the Ibero-Maurusian, are to be regarded as specialised and locally evolved Aurignacian.

The skeletal material from Afalou is examined by MM. Boule, Verneau and Vallois. It consists of fifty skulls and nine complete or approximately complete skeletons, of which ten are definitely not adult. All the skulls are robust in type, but, with the aid in certain cases of the indications afforded by the pelvis, 26 men and 14 women can be distinguished among the adults. Thirty-two of the adult skulls are now sufficiently complete for measurement in detail. They present a well-marked type. The cranium is of medium form, the face broad and low, with well-marked glabella and superciliary ridges. The cheek bones and zygomatic arches are massive. There is no prognathism. The maximum length varies from 193 mm. to 206 mm. and breadth from 133 mm. to 159 mm. It will be noted that in breadth they approach that of brachycephalic or mesocephalic peoples of Europe. The mean of the cranial capacity for men is 1,622 c.c., for women 1,456 c.c. Essentially they are dolichocephalic, or mesocephalic, and the sexual difference is insignificant. Evulsion of the upper incisors was practised. Taken as a whole, the remains represent a homogeneous group which, as indicated by the long bones, was of more than average stature. The bones of the skeletons have been subjected to a careful examination, of which the results are described in detail.

As the result of a detailed comparison with the remains of fossil men of palæolithic age found in North Africa and also with 'fossil' man elsewhere, and more especially with the skeletal remains from Mechta el-Arbi, here studied and described as a complete whole for the first time, the authors conclude that Afalou man approaches most nearly to the Cro-Magnon man and belongs to a North African group, here styled "the Mechta type". This type persists through neolithic, bronze and iron ages and reappears in the population of the Canaries. Though it is possibly to be discerned in the Carthaginian and Roman periods, it appears to have contributed nothing to the modern Berber population.

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[*] Les grottes paléolithiques des Beni Segoual (Algérie). Par C. Arambourg, M. Boule, H. Vallois, R. Verneau. (Archives de l'Institut de Paléontologie humaine, Mémoire 13.) Pp. 242+22 plates. (Paris: Masson et Cie, 1934.) 180 francs.

Solar Telescope at Oxford

THE new solar telescope of the University Observatory, Oxford, which was formally declared open by the Vice-Chancellor on June 11, is in its essence a vertical Cassegrain telescope of 12½ inches aperture and 73 feet focal length. It gives a solar image some eight inches in diameter, and unlike the original tower telescopes (the 60 ft. and the 150-ft. at Mount Wilson) the present instrument is wholly free from chromatic aberration. Further, since the image is formed on the optical axis, the telescope is free from the extra axial aberrations characteristic of horizontal solar reflecting telescopes. Light is fed into the vertical Cassegrain telescope by a 16-in. cœlostat, driven by a synchronous motor, and a secondary mirror of the same aperture. Both cœlostat and secondary mirror are provided with electrical slow motions which are controlled by a portable keyboard near the focal plane of the instrument; the same keyboard also carries controls for focusing the Cassegrain mirror.

The telescope is unique in that it is the only large solar telescope in which all the optical parts are made of fused silica. Since fused silica has a coefficient of expansion 1/20 that of ordinary glass, and 1/7 that of pyrex, it follows that the differential expansion produced by solar radiation, which tends to make the plane mirrors concave and so to produce an astigmatic image, will be almost wholly avoided in this instrument. The telescope, mounted in the east tower of the observatory on the same pier and under the same dome which housed the De la Rue reflector, was constructed by Sir Howard Grubb, Parsons and Co., of Newcastle, the blanks for the fused silica discs having been supplied by the Thermal Syndicate, Ltd.

On the optical axis of the telescope lies the slit of a large Littrow spectrograph. The spectrograph has two 60° and one 30° prisms of six inches square aperture (height 6 inches, length of face 9·7 inches), and a collimating-camera lens of six inches aperture and some 30 feet focal length. It gives a dispersion at λ4200 of 2·6 mm. per A., and a theoretical resolving power of more than 300,000. The optical parts, supplied by Adam Hilger, Ltd., and a large minimum deviation mount, supplied by C. F. Casella and Co., Ltd., are mounted at one end of a 40-ft. brick tunnel constructed in the basement of the observatory. The spectrograph, which still lacks the essential temperature control for the prisms, the slit end and plate holder mechanism, and a guiding disc, will be completed as funds permit.

In declaring this equipment open, the Vice-Chancellor referred to the chequered history of attempts to establish a permanent observatory in Oxford. No less than three unsuccessful attempts have been made, namely Bishop Fell's failure to persuade Wren to incorporate an observatory in Tom Tower, the establishment of a temporary observatory for Halley in 1704 in New College Lane, and finally the construction of an observatory by the Radcliffe Trustees in 1773, now regrettably, from the point of view of Oxford at least, departing for South Africa. The University Observatory was built by the University some sixty years ago, and the fact that the University has, during a period of exceptional financial stringency, set aside some £3,700 for the purchase of the present equipment may be regarded as evidence both that it desires the present observatory to be a permanent institution, and that it desires to see the study of observational astronomy actively prosecuted at Oxford. The Vice-Chancellor concluded his remarks by expressing the warm hope that some donor, interested in the study of astronomy, would find it possible to provide the relatively small sum needed to complete this equipment.

After the Vice-Chancellor's declaration, and following a period when the instruments were inspected by the assembled company of astronomers, Oxford men of science and other members of the University, the proceedings were concluded by an address by Sir Arthur Eddington on "The Physics of the Sun". Sir Arthur pointed out that the sun may be regarded as composed of three parts, an airy appendage where the atoms are supported by radiation pressure, a middle region where the absorption lines are formed and which is therefore readily accessible for observation with the equipment which had just been inspected, and finally the observationally inaccessible deep-lying interior. While there is a temptation to separate what is observable from what can only be inferred, the creation of such artificial divisions is likely to lead to 'frontier incidents'. The sun is a unit and must be treated as such. Sir Arthur then went on to point out how, in spite of its inaccessibility, it is possible to infer much about the physical conditions in the deep interior, and how such information has been confirmed in a striking way by developments in nuclear physics. In moving a vote of thanks to the lecturer, Prof. E. A. Milne, in a peculiarly happy vein, referred to the many distinguished astronomers and solar physicists who gathered to witness the ceremony and to hear Sir Arthur's masterly address.

H. H. P.

Interpretation of Spectra

PROF. HENRY NORRIS RUSSELL delivered the George Darwin Lecture to the Royal Astronomical Society at the meeting of the Society on June 14, taking as his subject "The Analysis of Spectra and its Application to Astronomy". Prof. Russell explained that he did not refer to the analysis of spectra in the sense of the analysis of the elements present or absent in a mixture, but to the analysis of the spectrum of each single element. The history of this analysis goes back to 1883, when it was discovered that the various doublets in the spectrum of sodium possessed the same separation when expressed in wave numbers: Prof. Russell followed the development of this subject down to its rationalisation by Bohr and the introduction of the notion of states of energy which the atom may possess, the frequencies of the spectral lines being given by the familiar quantum relation $h\nu = E_1 - E_2$

Comparatively recently, Hund has given a theory of the way in which the energy states of the atom are built up from the energies of the various electrons in the atom, and there is now a corpus of complicated but definite rules which govern the way in which levels are built up and the restrictions on possible electron jumps, jumps between 'odd' and 'odd' terms, for example, being forbidden. We can now fully understand the structure of even a complicated spectrum such as that of iron.

Turning to the practice of the analysis of spectra, Prof Russell said that, before one could analyse a spectrum, one needed a list of lines with well-determined wave-lengths, the intensities of the lines, their temperature class (along the lines developed by King at Mount Wilson) and the Zeeman patterns. All the easy spectra have now been unravelled, but a few complex spectra remain to be analysed. Prof Russell showed a slide exhibiting the present state of completeness of the analysis of the spectra of all the elements. Amongst those which are least analysed are the spectra of gadolinium, terbium, dysprosium, holmium, erbium, thorium, and uranium, while among the lighter elements the spectra of phosphorus, sulphur and chromium are not well analysed.

The astrophysical applications of the newer spectrum analysis were numerous. Saha's relation between the numbers of neutral and ionised atoms present in equilibrium at a given temperature and pressure had given the key to the general interpretation of the stellar spectral sequence. Identifications of lines are made much more reliable when reference is made to the intensity to be expected from the line's place in a multiplet and to the excitation potential of the atom in the state which absorbs the line. Identifications in the far infra red spectra are particularly assisted by spectrum analysis, as very accurate wave-lengths are not to be obtained from laboratory measurement: a more accurate separation can sometimes be obtained from a corresponding separation in, say, the green, where good wave-lengths are obtainable. Again, the presence or absence of lines in the solar spectrum receives an explanation based on spectrum analysis. The non-metals do not show strongly, because the lines arising from atomic states with low excitation potentials lie in inaccessible regions of the spectrum. The great majority of apparent variations in abundance between the earth's crust and the solar disc is explained by the excitation potentials of the lines that are available. Only phosphorus, bismuth and radium are truly absent in the sun. Passing on to quantitative analysis, the theory of R H Fowler and Milne explained the major features of the spectral sequence, the apparent differences between one spectrum and another being due to differences in surface temperature and surface gravity.

Prof Russell went on to say that while we recognise that a strong absorption line indicates many absorbing atoms and a weak line few, the detailed physical analysis is difficult. Dr W S Adams and Prof Russell had calibrated Rowland's scale of intensities—an arbitrary scale—by comparing Rowland's estimates of relative intensities within a large number of multiplets with theoretical intensities, and had applied this to the analysis of a number of stellar spectra. They discovered a departure from thermodynamical equilibrium, but recent work by Struve has thrown doubt on this method of calibration and the departure from thermodynamical equilibrium must now be regarded with caution. Prof Russell concluded the lecture by referring briefly to bright line spectra and to the spectra of the planets.

Association of Teachers in Technical Institutions

AT the twenty sixth Annual Conference of the Association of Teachers in Technical Institutions, which was held at Bournemouth during Whitsuntide, Mr D. W Lloyd (Old Trafford Technical Institute, Stretford) was installed as president for 1935–36 by the retiring president, Mr H J Cull (Central Technical College, Birmingham).

In his presidential address, Mr Lloyd said that during the past twenty five years two dominant motives have been apparent—the desire to preserve and extend liberty of thought and speech and the desire to mitigate human toil. The first is in the realm of social and political life; the second in the sphere of science and industry. Both, however, have produced effects which are world-wide and touch the sphere of education at every point. To the technical teacher, said Mr Lloyd, the tremendous changes in our industrial system due to technological development must have special significance. "Magic has entered our research laboratories, scientific advancement and the mechanisation of industry have tended to shorten hours of labour and increased the possibilities for leisure, yet, in our present stage of our development, we are faced with the chaos and misery of unemployment." Rationalisation, he continued, is one of the results of the increasing application of science to industry; but it has produced (by the replacement of as many employees as possible by the minimum number of machines) the paradox of a world of increasing production in which vast numbers are unable to secure the necessities of life. The machine, however, should not be arrested, since mechanical perfection increases human possibilities, and since the machine can "do the job better than its creator".

Long-range planning in industry and education, however, becomes essential. "The isolation of countries has disappeared . . geographical barriers are non-existent except to those who think in ancient terms, international wireless communication has no limits unless hampered by those who fear the free movement of thought . . new industrial contacts are possible, under control they can expand and make friendships. Education in its widest aspects can become an international force, and thus help to replace the narrow spirit of nationalism by the wider appeal of internationalism."

Mr Lloyd specially stressed the need for liberty of thought. The unrest of the present world, he said, has produced intolerance and the stifling of criticism; in certain cases it has led to the establishment of dictatorial power which must have a reactionary effect on educational progress. Civilisation cannot advance without criticism, and the subjection of the individual will by inhibitions from the outside leads to stagnation and putrefaction. Propositions which may seem obscene, heretical and revolutionary will get their deserts if openly discussed; but if they are suppressed they will permeate society through insidious channels and do irreparable injury. Freedom to think, freedom to voice one's thoughts within reason, are essential to human progress.

The Conference approved the recommendations of the "Report on Policy in Technical Education" recently published by the Associations of Technical Institutions, Teachers in Technical Institutions, and Principals of Technical Institutions and the National Society of Art Masters Among other resolutions passed was included one urging the establishment of a system of compulsory part-time day education for all young persons from the age of ceasing compulsory attendance at schools giving full-time education to the date at which the pupil attains the age of eighteen years. The Association reiterated its opinion that the raising of the school leaving age is more than ever desirable. In view of Mr. Lloyd's address, special interest centred about a resolution urging that the conditions of apprenticeship should be restated for the several industries, and that special consideration should be given to the claims of young people who have satisfactorily completed a full-time course in approved technical institutions in respect of the age at which they may be recruited, and the period of time required of them for completion of apprenticeship.

University and Educational Intelligence

CAMBRIDGE.—Dr. Leslie Harris, director of the Nutritional Laboratory, has been awarded the degree of Sc.D. Dr. Harris is known for his work on vitamins and proteins, and for the latter was awarded the Meldola Medal by the Institute of Chemistry in 1924.

EDINBURGH.—Dr. Otto Samson has been appointed Tweedie fellow for 1935–36 and 1936–37. This fellowship is awarded to enable the holder to carry out exploration and research in the less-known regions of Asia and northern Africa Dr. Otto Samson was born in Hamburg in 1900, and studied political science and then Oriental languages at the University there. In 1928 he entered the famous Ethnographical Museum (Museum für Völkerkunde) in Hamburg, and in 1930 became head of the East Asiatic Section, a post he held until the Nazi revolution in 1933. In 1931–32 he travelled in China to collect ethnographic specimens for the Museum. In the course of his travels he made an intimate study of the daily life of peasants and craftsmen and of the technical processes employed by them An examination of the data then collected suggested connexions with India reflected in craft and agricultural processes and their products. It is the extent and direction of the influence of China upon India and vice versa that Dr. Samson now proposes to study.

LONDON.—The Governing Body of the Imperial College of Science and Technology has elected to an Imperial College fellowship Prof. Alfred Fowler, late Yarrow professor of the Royal Society, and emeritus professor of astrophysics in the College.

OXFORD.—The new solar tower telescope was opened at the University Observatory by the Vice-Chancellor on June 11 (see p. 1047).

Sir Peter Chalmers Mitchell (scholar 1884–88), and Prof. N. V. Sidgwick (scholar 1892–96) have been elected honorary students (that is, fellows) of Christ Church.

The course of lectures on the work of early Oxford men of science finished for the session with Dr. R. T. Gunther's lecture at Exeter College Special reference was made to the work of Borlase on the antiquities and mineralogy, and of Walter Moyle on the ornithology of Cornwall Of outstanding importance was the advance in the science of geology due to Sir Charles Lyell, while the history of mathematics and astronomy owes much to Prof. Steven Rigaud, whose library was dispersed by the Radcliffe Trustees less than two months ago. Dr Gunther concluded with a tribute to the biologists, Prof H. N. Moseley of *Challenger* fame, Sir Baldwin Spencer of Australia and Sir Ray Lankester—all of Exeter College

THE University of Pittsburgh has conferred the honorary degree of doctor of science on Dr William A. Hamor, assistant director of Mellon Institute of Industrial Research, Pittsburgh.

MR. H. G ROBINSON has been appointed principal of the Midland Agricultural College, Loughborough, in succession to the late Dr. T. Milburn. Mr Robinson, who is a graduate of the University of Durham, is a son of Mr G. Goland Robinson, a well-known south Westmorland farmer. Since 1929, he has been farm director in the Midland Agricultural College.

Science News a Century Ago

Portrait of Count Rumford

In June 1835, the Managers of the Royal Institution received and accepted from Sarah, Countess Rumford, the portrait of her father, Count Rumford, the founder of the Institution, which hangs now in the Managers' room. The painting, which presents the Count in uniform, is of head and shoulders in profile. It is by an unknown artist, but is believed to be a good likeness. Count Rumford, who died in Paris in 1814, had kept the lease of his house at Brompton, although he had not lived in it for many years. His daughter occupied it again in 1815, and lived there at intervals until 1835. In that year she returned to America, presenting the portrait to the Royal Institution as a parting gift.

Roberts's Miners' Safety Lamp

According to *The Times*, on June 23, 1835, a lecture was given to the Eastern Literary and Scientific Institution by Mr Taylor in the room usually used by the Institution in Hackney Road "The subject of the lecture was the safety lamp, and the object of the lecture was to show, by actual experiment, that the lamp hitherto used in coal-mines, and invented by Sir H. Davy, is dangerous and insecure, and that a lamp invented by Mr. Roberts is perfectly safe and free from the defects which render the lamp of Sir H. Davy not to be depended on by the miners. Mr. Roberts, who has already received several medals from the Society for the Encouragement of Arts, Manufactures and Commerce, was in attendance and produced the lamp invented by Sir H. Davy and his own lamp, and assisted Mr. Taylor in the lecture and in the experiments"

Roberts's lamp was described as being "surrounded by a double tube of wire gauze, and also by a glass chimney, and is so constructed that a current of carbonic acid air or nitrogen passes continually between the external atmosphere and the flame of the lamp To comprehend the nature of this invention fully, it is necessary to see the lamp, and compare it with the lamp hitherto used, over which it has certainly a manifest advantage It is very simple in its construction, and as a committee of the House of Commons are now examining matters of this nature, it will no doubt meet with the encouragement it deserves"

London's Water Supply

Commenting on a proposal to supply London with water pumped from wells by steam engines, the *Athenæum* of June 27, 1835, after reviewing the project, said 'The annually decreasing quantity of water in the London bason is also to be remarked The fall in the level of the wells is, according to credible evidence, about one foot per annum, and there has been a decrease of full twenty feet within the last twenty years Though this gradual fall is certainly not an object of immediate apprehension, as to the total failure of the supply, yet the infinitely more rapid ratio of decrease which would ensue, if the whole metropolitan supply were taken from the same source, must be obvious

"For these reasons we have come to the conclusion that though London is supplied with a considerable abundance of the most salubrious well-water for general purposes of domestic use—yet, that to draw upon the bason for the whole of the supplies by means of steam power is, if not objectionable for other reasons, impracticable by reason of the expense of the many divided establishments which must necessarily be required for the production of 20,000,000 galls per day, which is the generally estimated quantity used in the metropolis"

The Hot Blast at the Butterley Iron Works

For some years after the introduction by Neilson of the hot-blast, there was considerable controversy over its merits One of its advocates was Joseph Glynn, F R S (1799–1863), who was engineer to the Butterley Iron Works, near Derby. In a letter of his published in the *Mechanics' Magazine* of June 27, 1835, he said: "The Butterley Company employ in their mines, coal-fields, blast furnaces, rolling mills, forges, boring mills and steam engine factory, 35 steam engines of all sizes, from 80 inches of diameter of cylinder, and have six blast furnaces, of which four are now at work. The whole of these furnaces are blown with heated air, and the coal, which is admirably adapted for the purpose, needs no cokery, being very carbonaceous The mountain limestone which lies but three miles from the furnace, is used as flux for the ore, which is clay iron-stone. These materials produce a very fine grained cast-iron, remarkably soft and fluid, and at the same time they are equally well adapted to make 'forge pigs' from which are manufactured bars, hoops and boiler plates, of best quality and steam engines . . M. Dufresnoy, M. Perdonnet, and several other Frenchmen of scientific reputation, have visited the Butterley Company's works, with which they have been highly pleased, and have been willing to communicate the valuable information they possess, in return for such as was afforded them here".

Societies and Academies

DUBLIN

Royal Irish Academy, May 27. WINIFRED E FROST Larval stages of the Euphausiids *Nematoscelis megalops* and *Stylocheiron longicorne* taken off the south-west coast of Ireland The euphausiids form an important part of the fauna of the inshore and deep waters off the south and west coast of Ireland The present paper deals with the life-histories of two of these animals, the development of which has not previously been described Sufficient larval stages have been found to give a good idea of the life-history of the organisms and the descriptions make it possible to identify the larvæ in the plankton Some notes are given on the reproductive cycles of the two euphausiids

PARIS

Academy of Sciences, May 6 (*C R*, 200, 1553–1640) LUCIEN CAYEUX. The constitution of the Senonian phosphates of Syria ALEXANDRE GUILLIERMOND: A new fungus, a parasite of the capsules of the cotton plant *Eremothecium Ashbyii* and its possible relations with *Spermophthora Gossypii* and the Ascomycetes ARMAND DE GRAMONT and DANIEL BERETZKI The stabilisation of a frequency of beat (quartz oscillators) by compensation of the temperature coefficients The method is based on the use of two piezoelectric quartz crystals and different frequencies and determined temperature coefficients The arrangement is more stable than that utilising a single quartz with low temperature coefficient, and its constancy over a range of 50° C is equal to a single quartz kept within 0 1° C HENRI DEVAUX The adsorption of ovalbumen at the free surface of its solutions when the concentration of these varies from 10^{-3} to 10^{-6}. GEORGES TZITZÉICA Some affine properties IVAN BRAÏTZEFF. The singularities of special types of a function given by its development in a Dirichlet series. MICHEL KRAWTCHOUK. Some inequalities in the problem of moments NATAN ARONSZAJN The singularities of the Riemann surfaces of inverse functions of integral functions HENRI MINEUR: Mechanical systems admitting *n* uniform first integrals and the extension to these systems of Sommerfeld's method of quantification MIROSLAV NÉNADOVITCH: Contribution to the study in a plane current of rigid biplane cells. RAOUL GOUDEY. Measurements of the intensity of gravity, made in 1933, with the Holweck-Lejay gravimeter No 2. GEORGES DÉCHÈNE. The discharge rays emitted by a brush discharge. Contrary to the views of Dauvillier, the author's experiments confirm the existence of discharge rays MLLE. M. QUINTIN: Study of the electromotive force of cadmium chloride batteries. FRANÇOIS CROZE The general formulæ of the refraction of a light bundle. JEAN PAUL MATHIEU and JACQUES PERRICHET: The rotatory dispersion of the α-halogen derivatives of camphor. ANDRÉ CLAUDE: Incandescent lamps containing krypton and xenon. A summary of results obtained with more than 10,000 bulbs On account of the lower heat conductivity of krypton and xenon compared with that of argon the bulbs can be made smaller, a litre of gas filling 20–30 bulbs. The temperature of the filament can be raised, owing to the slower diffusion of the tungsten vapour. JEAN PERREU: The tonometry of saline solutions. PAUL ABADIE and GEORGES CHAMPETIER: The determination of some dielectric properties of heavy water PAUL GOLDFINGER, WLADIMIR LASAREFF and MORICE LETORT. Thermochemical considerations on the carbonyl group PIERRE SPACU: A method for the quantitative separation of iron and cobalt The ferric iron is precipitated by pyridine and the cobalt in the filtrate precipitated as the ammine CoPy$_4$(SCN)$_2$ MARCEL PATRY: The properties of allotelluric acid MARCEL GODCHOT, MAX MOUSSERON and ROGER RICHAUD The Δ_2 and Δ_3 1-methylcyclopentenes and their derivatives V M MITCHOVITCH. The action of *o*-chlorcyclopentanone on the organomagnesium halides FIRMIN GOVAERT The use of liquid hydrogen chloride in the preparation of the dichlorarsines JEAN LAVAL The diffraction of X-rays by the silver atom (factor of structure) HENRI LONGCHAMBON The chemical formula and constitution of Ampandrandava sepiolite. JEAN ECK and JEAN MENABREA: The arrangement of the faces of the trihedra obtained by the corrosion of a plate of quartz JOSEPH BLAYAC, RODOLPHE BÖHM and GASTON DELÉPINE. A new Goniatite fauna in the Visean of Montagne-Noire H BESAIRIE, P GRUYELLE, A LENOBLE and A SAVORNIN The geological and magnetic study of the cliff of Mandraka (Madagascar). V FROLOW: The general characters of the changes of level or of flow ALBERT MAIGE New observations on the evolution of the amylogen plasts in the reserve starch cells. WLADYSLAW ANTONI BECKER and FRANÇOIS XAVIER SKUPIENSKI. Vital protoplasmatic observations on *Basidiobolus ranarum*. ROBERT BONNET and RAYMOND JACQUOT The variation of the velocity of growth and of respiration in *Sterigmatocystis nigra* and of the crude energy yield, as a function of the age of the cultures and the source of nitrogen. CAESAR R SCHOLZ. The constitution of corynanthine RENÉ SOUÈGES. The embryogeny of the Œnotheraceæ The principal terms of the development of the embryo in *Ludwigia palustris* ROBERT WEILL: The structure, origin and cytological interpretation of the colloblasts of *Lampetia pancerina* (Ctenophores) RAOUL HUSSON The rôle of the laryngeal apparatus in the formation of the timbre of spoken and sung vowels and the genesis of the changes of compass and registers of the voice. MME. VÉRA DANTCHAKOFF. Endocrinian proliferations at the expense of the germinative epithelium RENÉ AUDUBERT and ROBERT LÉVY: The emission of radiation by nerve stimulation MICHEL FAGUET The photometric diagnosis of the Eberth bacillus, of para *A* and of the coli bacillus The photometric method of measuring the rate of increase described in a previous note has been applied to twelve strains of coli, eleven strains of the Eberth bacillus and six of para *A*. Each gives its characteristic curve and the photometric diagnosis agrees with the bacteriological diagnosis. GASTON RAMON and EDOUARD LEMÉTAYER: The reinforcement of the immunising action of toxins and antitoxins. The method is based on coating the toxin or anatoxin with lanoline.

COPENHAGEN

Royal Danish Academy of Sciences and Letters, February 1. G. HEVESY: Artificial radioactivity of scandium. When scandium is bombarded with neutrons, the product is partly a radioactive isotope of potassium, and partly a radioactive isotope of scandium, the former emitting hard, the latter soft β-rays.

March 1. L. KOLDERUP ROSENVINGE: Some Danish Phæophyceæ. The development of the two species of *Stictyosiphon* occurring in Danish waters (*S tortilis* and *S soriferus*) has been examined, the germination of the zoospores from the plurilocular sporangia having been observed, in both cases apparently without fusion In both species a filiform, branched, creeping protonema was produced on which an erect shoot appeared, bearing plurilocular sporangia, just as the mother plant An alternation of generations therefore does not take place The morphology of the Danish members of the family Elachistaceæ was discussed

GENEVA

Society of Physics and Natural History, May 2. FERNAND CHODAT Tyrosinase and glutathione The experiments carried out prove that glutathione completely inhibits catalyses determined by tyrosinase on tyrosine, *p*-oxyphenylethylamine and the system *p*-cresol-glycocol The inhibiting rôle of glutathione in melanogenesis *in vivo* is considered FERNAND CHODAT and ANDRÉ MIRIMANOFF: The ageing of yeasts *Endomyces anomalus* is studied from the point of view of its respiration The ageing consists in leaving fresh yeasts, in buffer solutions of phosphate, with or without sugar at different temperatures The respiratory power is measured with Warburg's apparatus under these different conditions G TIERCY. (1) Remarks on the differential equation of the second order met with in cases of polytropic equilibrium of gaseous spheres The paper discusses the examination of an energy hypothesis utilised by Białobrzeski and by Eddington (2) The general differential of the second order characterising the thermodynamic equilibrium of gaseous spheres This equation is complicated, it is always simplified when the case of polytropic equilibrium is considered.

LENINGRAD

Academy of Sciences (*C R*, 1, No 9, 1935) D PEREPELKIN Parallel varieties in a Euclidian (or Riemannian) space L SCHIEFNER. The *m*-th power of a matrix G KRUTKOV and V. DMITRIEV Contribution to the theory of Brownian movement. Small fluctuations of a system with *n* grades of freedom. D VOLKOV An exact solution of the Dirac equation for a flat wave of definite frequency E. ANDREJEV Influence of a metallic surface on the kinetics of oxidation of ethane K LJALIKOV, I PROTAS and G. FAERMAN Displacement of the isoelectric point of gelatine. V IPATJEV and V. TRONEV Mechanism of displacement of noble metals in solutions of their salts by hydrogen under pressure. (1) Displacement of palladium in solutions of palladium chloride (2) Displacement of metals in the solutions of H$_2$PtCl$_6$, H$_2$IrCl$_6$, Na$_2$IrCl$_6$ and Na$_3$RhCl$_6$. O ISTOMINA and E OSTROVSKIJ: Effect of super-sonic vibrations on potato growth. K. SUKHORUKOV and T EPEL-BOGOSLOVSKAJA: Action of bios on processes of putrefaction V. SHARONOV. Daylight illumination under different conditions. A. LABUNCOV: Age of uraninite and monazite from the pegmatite veins of northern Karelia. I. ALIMARIN. Chemical constitution of tshevkinit DONTCHO KOSTOFF: Studies on polyploid plants. (10) The so-called 'constancy' of the amphidiploid plants. G. MELLER and A PROKOFJEVA Structure of the chromonema of the inert region of the *X*-chromosome of *Drosophila*. V KATUNSKIJ Growth-promoting substance as a factor in the formation of the plant organism. V. CIVINSKIJ.

Critical period of the cotton plant. L. POLEZHAJEV: Restoration of the regenerative power in tailless amphibians (2).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **21**, 143–180, March 15, 1935). JAN SCHILT. Preliminary note concerning a new theory of the motions of the stars. The parallaxes of stars of spectral type *A* are used to give rectangular equatorial velocity components, and an expression is derived from which other parallaxes have been derived satisfactorily The formula incorporates the hypothesis of an expanding stellar system. HARRIET B. CREIGHTON and BARBARA MCCLINTOCK. The correlation of cytological and genetical crossing-over in *Zea mays*. a corroboration. Chromosome 9 in maize is characterised by the 1 2 ratio in length of its two 'arms'; in some strains the shorter arm carries a large knob, whereas in others it is small or absent. This knob has been used as a cytological 'marker' FRANK H. CLARK: Two hereditary types of hydrocephalus in the house mouse (*Mus musculus*). The character is a simple recessive. Since mice with water-on-the-brain are sterile or transit only a low grade of this affection, heterozygous animals were used. When such animals of two strains, one from Michigan and the other from Berlin, were mated, the offspring contained no hydrocephalics, indicating that two different genes are involved in the two strains. TORSTEN TEORELL: Studies on the 'diffusion effect' upon ionic distribution. (1) Some theoretical considerations. Study of an aqueous system of strong electrolytes where steady diffusion across a boundary permeable to ions takes place The theory predicts a distribution of ions similar to that for non-diffusible ions indicated by the Gibbs-Donnan equilibrium, which appears as a limiting case of the general theory discussed. Great concentration differences such as occur in biological systems are theoretically possible. H. S. VANDIVER: On the foundations of a constructive theory of discrete commutative algebra (2) J. LEVINE: Conformal-affine connexions. OSWALD VEBLEN: Formalism for conformal geometry. H. BATEMAN and S. O RICE: Some expansions associated with Bessel functions. ROBERT W. WILSON. *Simimys*, a new name to replace *Eumysops*, Wilson, preoccupied: a correction.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, June 23

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30. Miss M. Smith: "Reptiles and Fossil Reptiles".*

Monday, June 24

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Annual General Meeting.

BRITISH WATERWORKS ASSOCIATION, June 25–29. Annual General Meeting and Conference to be held at Cambridge.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, June 26–29 Annual Congress to be held at Bournemouth. Prof. A. C. Seward: "The Herbarium of the Rocks" (Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

The Scientific Journal of the Royal College of Science. Vol 5· Containing Papers read during the Session 1934–1935 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp 138 (London. Edward Arnold and Co) 7*s*. 6*d* net.

Report of the National Baby Week Council 1934, presented and adopted at the Eighteenth Annual Meeting of the National Baby Week Council held in London on the 27th March 1935 Pp 24 (London National Baby Week Council.)

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1935 Pp 63+6 plates (Edinburgh Zoological Society of Scotland)

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 23 On the Characteristics of *Bacterium violaceum* (Schröter) and some Allied Species of Violet Bacteria By George Cruess-Callaghan and M J. Gorman Pp 213–221+1 plate (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd, 1935) 1*s*

The Men of the Trees Tenth Year's Report and Review of the Tree Year 1934 Pp 39+4 plates. (London Men of the Trees) 6*d*

Right and Might an Argument for an International Police Force By Alan Burnett Rae (Series B, No. 7B) Pp 18 (London The New Commonwealth.) 3*d*

The Strangeways Research Laboratory, Cambridge Report for 1934 Pp 26 (Cambridge Strangeways Research Laboratory)

Department of Scientific and Industrial Research Report of the Chemistry Research Board for the Period ended 31st December 1934, with Historical Introduction and Report by the Director of Chemical Research. Pp v+94 (London H.M. Stationery Office) 1*s* 6*d* net.

Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation submitted to the Fourteenth Annual General Meeting on May 28th, 1935 Pp ii+66 (London Empire Cotton Growing Corporation)

Report on the Fisheries of Palestine By James Hornell (Published on behalf of the Government of Palestine) Pp 106 (London. Crown Agents for the Colonies) 7*s* 6*d*

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1935, June 1 Pp. 24 (Greenwich Royal Observatory)

The Institution of Gas Engineers Communication No 107 72nd Annual Report and Accounts of the Council of the Institution of Gas Engineers to be presented at the 72nd Annual General Meeting to be held at the Institution of Civil Engineers, Great George Street, London, S W 1, on the 4th, 5th and 6th June 1935 Pp. 39 (London: Institution of Gas Engineers)

OTHER COUNTRIES

Indian Central Cotton Committee. Technological Laboratory Technological Bulletin, Series B, No 19· Effect of Storage prior to Ginning on the Spinning Quality of Cotton By Dr Nazir Ahmad. (Pp 13) (Bombay. Indian Central Cotton Committee.) 8 annas

Canada Department of Mines Mines Branch Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1933. (No 744) Pp iv+194 (Ottawa: King's Printer)

Scent and the Weather By Flight-Lieut R G Veryard. (No. 1935/3) Pp iv+33+5 plates (Chaman, Baluchistan: The Masters of Foxhounds Association of India) 3 rupees

Studies from the Connaught Laboratories, University of Toronto Vol. 6 1933–1934 Pp vii+78 papers (Toronto. University of Toronto Press)

Survey of India General Report, 1934, from 1st October 1933 to 30th September 1934 Pp vi+73+11 plates. (Calcutta. Survey of India) 1 8 rupees, 2*s*. 6*d*

India Meteorological Department Scientific Notes, Vol. 6, No 61: Evaporation in India calculated from other Meteorological Factors By P K. Raman and V Satakopan Pp. 51+6 plates. (Delhi Manager of Publications) 1 12 rupees, 3*s*

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 119 Buckling and Failure of Thin Rectangular Plates in Compression. By Mineo Yamamoto and Kazuo Kondo Pp 22 25 sen. No 120 Further Studies on the Effect of the Ground upon the Lift of a Monoplane Aerofoil. By Susumu Tomotika Pp. 23–44. 25 sen (Tôkyô Kôgyô Tosho Kabushiki Kaisha.)

Ministry of the Interior, Egypt Department of Public Health. The Research Institute and the Endemic Diseases Hospital. Third Annual Report 1933 Pp xii+108+14 plates (Cairo. Government Press.)

Ministry of Public Works, Egypt Physical Department. Helwan Observatory Bulletin No. 38. Sixth List of Nebulae photographed with the Reynolds Reflector. By M. R. Madwar. Pp. 15. (Cairo: Government Press.) 5 P T.

Science Reports of the Tokyo Bunrika Daigaku, Section A. No. 40· On the Theory of Multivalent Functions. By Shigeo Ozaki. Pp 167–188. (Tokyo Maruzen Co, Ltd.) 35 sen.

The University of Colorado Studies Vol. 22, Nos. 2 and 3· The Poetry of José Mármol. By Dr Stuart Cuthbertson. (University of Colorado Bulletin, Vol. 35, No. 12) Pp. iv+83–276. (Boulder, Colo.: University of Colorado.) 2 dollars.

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 6, No 4 Höjdbestämningar vid Sveriges kuster medelst hydrografisk Nivellering. Av Folke Bergsten. Pp. 10. (Stockholm. Statens Meteorologisk-Hydrografiska Anstalt.) 1.50 kr.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 14, 1932, iii. Vattenstånden vid Rikets kuster. Pp. 25. 2 00 kr. Årsbok, 15, 1933. v. Hydrografiska mätningar i Sverige. Pp. 39. 3.00 kr. vi. Aerologiska iakttagelser i Sverige. Pp. 11. 2.50 kr. Årsbok, 16, 1934. i. Månadsöversikt över väderlek och vattentillgång jämte anstaltens arsberättelse. Pp. 89. 2 50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.)

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Social Research and Industrial Reorganisation

ASSOCIATED with the general satisfaction at the improvement in trade which finds expression to-day, there is a desire to understand, and use to advantage, the factors responsible for the better conditions which prevail. It is clear that, on the whole, 1934 recorded a distinct advance over 1933. In most countries unemployment continued to diminish, production to increase and exchanges remained more stable. In some countries the belief became current that the depression was already passing into history. While, however, it may be fairly said that the world's economic life has been running in smoother and deeper channels, it is still far from having returned to the broad, even flow of real prosperity. The imminent dangers of renewed international competition in armaments alone should make even the most thoughtless pause before indulging in extravagant prophecy about the return of an age of prosperity, but there are many other facts which should discourage easy optimism. Not the least of our present perils is that the improvement in trade which has undoubtedly been experienced in Great Britain and elsewhere may be interpreted by partisans as the fruit of policies and methods which impartial investigation might reveal as really hindering recovery.

The annual reports of the director of the International Labour Office provide an expert examination and analysis of the social and economic conditions of the world which assists even the layman to probe the partisan claims with which he is often assailed. Mr. H. B. Butler's latest report* is no exception to the rule. His analysis shows clearly that hopes of a general recovery have not materialised. Recovery is still superficial rather than fundamental. There is still widespread distress and frustration of hope. There is no sign of a general swing-back of the pendulum to prosperity without any basic disturbance of the economic system having taken place and without any serious political consequences having ensued.

There is much indeed in Mr. Butler's survey that is not only highly interesting to scientific workers, but also significantly in line with the conclusions of many among them who have endeavoured to arrive at an impartial opinion on the present situation and the means of recovery. Controversy still unfortunately rages round many questions such as that of public works as a remedy for unemployment, nurtured more by the desire to prove or disprove the value of some economic doctrine or political attitude than by any judgment of the real facts.

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* Report of the Director, International Labour Office, Geneva, 1935

If, however, there is one thing which is more and more clearly evident, it is that policies of temporising or dalliance with prejudice rather than facts are not only ineffective but also liable to be disastrous Everywhere fatalistic belief is giving way to the demand for systematic collective action, and Mr. Butler in his survey notes that, in dealing with the problems presented by the depression, those Governments which have adopted unorthodox measures have, on the whole, succeeded better than those which have relied on the traditional processes. Deliberate interference by the State in economic affairs has continued to increase rather than to diminish. Its success appears to be justifying and strengthening the popular belief that by bold, well-conceived steps planned on a sufficiently comprehensive scale, Governments can influence the course of recovery to a very considerable extent.

This growing reluctance to accept the thesis that human agencies are impotent to control the fluctuations of economic fortune is one of the most significant and hopeful signs of the present time Its very existence is a psychological element in the general situation which cannot be ignored In addition, it represents not merely confidence in the ability of man to regain control over events, but also a willingness to accept change, to try new methods It is a hopeful sign in itself which permits the co-operation of the scientific worker and the application of the scientific method to these difficult problems There could be no greater tragedy than for the slight recovery which has been experienced in the last year to blind us to the necessity for fundamental investigations and perhaps changes of policy and methods, if the full recovery and the alleviation of the hard core of unemployment and general distress, which are undoubtedly within our powers, are to be secured.

Against this very real danger, one of the surest safeguards is the extent to which recent and more fundamental attempts to modify and adapt the old economic structure to meet the new conditions have been inspired in the main by social considerations. It is not merely that Governments are expected to devote the same energy, ingenuity and attention to the provision of the elementary needs of feeding, clothing and shelter on a civilised scale as to the promotion of air communications, wireless services and elaborate systems of national defence Questions of organisation of industry, hours of work and the like are judged more and more from a social point of view than from that of financial or technical efficiency alone.

To these social implications, Mr. Butler, in the report to which we have referred, directs special attention In commenting on relief of unemployment, he points out that the failure of relief, while warding off actual starvation, to prevent progressive under-nourishment and demoralisation of individuals and families where unemployment is of long duration, is leading to an increasing demand for adoption by the State of energetic measures to create work, whether direct or indirect. His reference to the devastating effect of juvenile unemployment is pertinent in relation to the Jubilee Trust Fund recently inaugurated in Great Britain For juvenile unemployment, relief affords no solution. "No social problem is of more vital importance and it may safely be said that money saved by ignoring the dangers of intellectual, physical and moral deterioration to which the young unemployed are exposed represents the worst and most short-minded form of national economy".

This growing insistence on the importance of the social factor coincides with a wider recognition of its importance on the part of scientific workers themselves. Julian Huxley has suggested that the main trend of post-War thought, where not merely pessimistic or destructive, is in the direction of science tempered by humanism ; and the refusal of public opinion to consider the improvement of production, the growth of retail sales or the appreciation of securities as in themselves satisfactory unless accompanied by a corresponding reduction of unemployment, is paralleled by growing attention to the social factors on the part of scientific workers, whether as affecting the direction or conditions of their own work or as a field for further investigation.

It is in fact at last being widely realised that an elaborate mechanical organisation is often a temporary and expensive substitute for an effective social organisation or a sound biological adaptation. The error of confusing efficiency with adaptation to large-scale production is being more and more apparent, and in many fields, organisation and processes are being judged less by their purely mechanical or technical efficiency than by their social consequences in the widest sense. What the product contributes to the labourer becomes as important as what the worker contributes to the product.

From this point of view the ideal of fitness for a purpose implicit in technology acquires a new significance. The rationalisation of industry is no longer considered merely from a technical or economic point of view The entire social situation must be taken into account. A process which promises higher technical efficiency may indeed be rejected, for example, either because of the untoward disturbances it produces in the State as a whole or because of the risks it involves to the health of the worker. As Mumford suggests in "Technics and Civilisation", "a rational society might alter the process of motor car assemblage at some loss of speed and cheapness to arrive at a more interesting routine for the worker Similarly it would either go to the expense of equipping dry-process cement-making plants with dust removers—or replace the product itself with a less noxious substitute. When neither alternative was practicable it would drastically reduce the demand itself to the lowest possible level".

In this attitude there is essentially no slowing up of progress On the contrary, while the direction of research may be changed, its scope is enlarged. The realisation that industry offers opportunities for creative experience which is social in its processes as well as in its objects gives a new impetus to research over a wide front Such bodies as the National Institute of Industrial Psychology are indeed only faintly foreshadowing the services which they can render, when industry and society are widely permeated with an ideal of efficiency or rationalisation which takes full account of the worker and the social consequences, as well as of the process, the product and the economic return The following out of the principle of economy in its highest and truest sense means that at least as much attention will be paid to the choice of the correct means of avoiding waste of human effort and welfare as to the choice of the appropriate apparatus or raw materials The stress laid upon the problem of unemployment in the midst of the Jubilee rejoicings emboldens the hope that, so far from the partial recovery already experienced leading us astray, there is a growing determination to seek new ways and means, if those of the past prove inadequate to solve this problem and secure the wider distribution of the vast resources at man's disposal, could he but make mechanisation his servant and not his master.

Reviews

The Arachnida

The Arachnida By Theodore H Savory Pp xi+218+8 plates. (London Edward Arnold and Co, 1935) 25s net

THE Arachnida have been unduly neglected by zoologists, having been overshadowed as objects of study by the beauty and infinite variety of the insects. The study of the class has been difficult, owing to the scattered literature and the scarcity of several of the forms. Of the ten existing orders, only four are represented in Great Britain, and several of the smaller orders do not reach the confines of Europe. Mr Savory has now given us a generalised account of the class as a whole, for which all zoologists and naturalists will be grateful.

The Arachnida, more than the insects, have attracted the attention of philosophical morphologists, since the days when Strauss-Dürkheim, so long ago as 1829, first pointed out that *Limulus* is an arachnid, and the close resemblance between that genus and the Eurypterida has long been recognised. It is remarkable that of these two primitive groups, *Limulus* has survived, being to-day not only by far the largest arachnid, but also the only marine one, while the Eurypterida, making their first appearance in the Cambrian, attained their zenith in the Silurian, producing such extreme forms as *Stylonurus* of the Old Red Sandstone, which reached the enormous size of ten feet, with very long legs These gerontic characters foretold an early extinction, for the order made its last appearance in the early Carboniferous

In discussing the evolution of the class, the author quotes the theory associated with the names of Ray Lankester and Pocock, according to which *Limulus* and the scorpions were both derived, each through an intermediate link, from the Eurypterida, which in turn, through *Limulava*, came from the Trilobites. In any event, all will agree that the Eurypterida, *Limulus* and the scorpions undoubtedly have a common origin Zittel derives all three from a hypothetical early Cambrian predecessor, reserving the Trilobites as ancestors of the Crustacea But, as the author points out, if by this hypothesis he would exclude the Trilobites from being at the same time ancestor of the Arachnida, he is virtually denying evolution

The critical step in the evolution of the class was in the Silurian, when they changed from an aquatic to a terrestrial habitat, *Limulus* alone retaining a marine life, with gill-books.

Leukart, Hansen and Sørensen, from a study of the breathing apparatus, draw conclusions different from the English morphologists. They regard the Palpigradi and Solifugæ as being the nearest survivors to the primitive type, which, they maintain, was terrestrial, the crustacean characters of *Limulus* being due to convergence.

Mr. Savory prefers to suspend judgment. He points out that the Arachnid-Crustacean-Myriapod group of the phylum Arthropoda are all built upon a 21-somite plan, and evolved from a vermiform ancestor, which must be sought in the pre-Cambrian in the *Onycophora*, as Versluys and Demoll have sought to establish.

As to the genetic relationship within the class, the one point on which there is general agreement is that the ten existing and seven extinct orders cannot be arranged in an ascending series. It is also accepted that the scorpions are the most primitive terrestrial forms, with the Pedipalpi and Solifugæ very close. The spiders are the most highly specialised, and the Acari are certainly degenerate, with the Opiliones intermediate. The system adopted by the author is that drawn by Pocock, with slight modifications, as the rejection of the Trilobites, which are now generally regarded as Crustacea, the inclusion of the fossil orders, and the rejection of the Pantopoda, Pentastomida and Tardigrada. From the discontinuous relationship between the orders, Mr. Savory draws the conclusion that "the hypothesis of an evolution taking place by slow successive degrees is not in accordance with the facts".

One feature of the Arachnida which makes them so attractive is their conservatism, the survival of such primitive and ancient forms as *Limulus* and the scorpions, which Ray Lankester has described as "the oldest animal form of high elaboration which has persisted to the present day". Scorpions first appear in the Silurian, as pioneers of the air-breathers, and were as highly developed by the Carboniferous as they are to-day. Four other orders share the pride of almost unaltered descent from Palæozoic days, the Opiliones, our familiar harvestmen, the Solifugæ or wind scorpions, and the Pedipalpi.

The most surprising group in the class is the Ricinulei or Podogona. These extraordinary little creatures, which have never evolved eyes, appear to have scarcely any sense organs and carry their genitalia in the tarsi, were first discovered in the Carboniferous of Illinois in 1837. In the following year Guérin described a living specimen from West Africa. Now there are six fossil and thirteen living species known, but the astonishing thing about them is that to-day, almost a century after their discovery as living creatures, only thirty-two specimens are known to exist. As the author says, each specimen seen by man is something of a historical event.

Mr. Savory's concern is not confined to the taxonomic and evolutionary aspect of the study. In the text he brings out many points of the highest interest, with a literary skill unusual in purely scientific works. He points out that the time has come for arachnology to possess the same unity and status enjoyed by entomology, and that the day has come for a science of comparative arachnology. He gives a series of essays, interlarded as 'Excursus', which well repay reading, and a clear summary of the structure, classification and evolution of the class, the habits of the creatures and their behaviour, in which he explains, for the non-specialist, modern views on instinct, reflexes and tropisms, with an indication of the work that has been done on their courtship, mating, dispersal, distribution and manner of life. To make the work complete, he includes an outline of those groups which have been doubtfully associated with the Arachnida, such as the Tardigrada, Linguatulidæ and Pycnogonidia, with essays on laboratory work, the economic aspect, and an outline bibliography.

M. B.

Theoretical Materials and Experimental Structures

(1) *Theory of Elasticity*. By Prof. S. Timoshenko. (Engineering Societies Monographs.) Pp. xvi+416. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30*s* net.

(2) Department of Scientific and Industrial Research. *Second Report of the Steel Structures Research Committee*. Pp. xviii+369+25 plates. (London: H.M. Stationery Office, 1934.) 7*s*. 6*d*. net.

FOUR of the leading engineering institutions of America have engaged in a fresh enterprise in technical literature. Selected manuscripts of value to engineers and industry, but of probably limited appeal because of their special nature or treatment, are to be produced in a series entitled "Engineering Societies Monographs". Prof. Timoshenko's volume is the first to be issued and gives a fine impression of the high standard intended.

The author's previous volumes on "Strength of Materials" (reviewed in NATURE, 128, 617, Oct. 10, 1931) dealt with engineering materials in a very thorough fashion, but in the order of development more usual in technical treatises on the subject. The present work on theory is guided largely by the mathematical bases, and in classification and details departs from this common order.

The mathematical method and the engineering method in theoretical development are in direct contrast. The former seeks primarily the most general treatment and formulation, and then particularises to elucidate problems of a class The engineering application is an exercise The latter method uses elementary theory so far as it will go, without greatly emphasising its shortcomings until it ceases to work satisfactorily The practical problem is the main aim; and the elementary methods are quite acceptable so long as they give rational guidance in design They do so in many important lines of study, such as bending theory, but it is the failure of these methods in the more difficult modern problems of construction that renders such a work as the present volume important and necessary to engineers

It has been estimated that 80–90 per cent of the failures occurring in modern engineering construction are due to fatigue. This evil displays itself as a progressive cracking developing from zones of high stress concentration due to form variations or discontinuities, holes, corners and re-entrant angles. The treatment of stress concentration is quite beyond the elementary theory, so prominent in engineering curricula, but the results in practice emphasise the failure of the theory—and the curricula—by the failure of the parts. The experience only slowly affects technical literature, but has certainly dated the older textbooks on materials. Prof. Timoshenko has taken a very active part in the investigation of the subject, and he is also to be congratulated on his activities in rewriting its literature

While it is necessary to decry the powers of elementary methods of stress analysis, it must not be supposed that more powerful mathematical methods can always provide full solutions. Investigation on materials and structural forms to-day is a remarkable mixture of analysis by formal elastic theory and by energy methods, by direct experiment; by indirect experiment such as the photo-elastic method; and by the use of analogies such as the soap film, the hydrodynamical and the electrical parallels. Prof. Timoshenko gives all these methods due attention. His book is not a mere array of theoretical developments, but a powerful attack upon, and a careful classification of, all methods aiding the solution of specific engineering applications.

The author's arrangement is of distinct interest Two-dimensional problems are dealt with by rectangular and polar co-ordinates and by the use of the complex variable. There is a general analysis in three-dimensional work with an extensive consideration of torsion and bending, including a careful discussion of analogous methods. Strain energy methods and theorems are adequately presented and there are special and characteristic chapters on axially symmetrical stresses and wave propagation Apart from the last, vibration problems are not considered; and instability problems are not dealt with in this text The wealth of reference, by footnote and otherwise, greatly enhances the value of the book, while it displays the author's scholarship and not infrequently discloses his personal share in the development of the subject.

(2) In Timoshenko's work the methods of theoretical investigation in elasticity are presented in classified array with the problems which they solve, help to solve or hope to solve But when these are gathered together, they cannot be found to include with any confidence in any category the apparently simple column and beam system that, with its connexions and supports, comprises the standard building frame. The method of inquiry into this important structural form initiated by the British Steelwork Association and directed by the Steel Structures Research Committee affords a definite contrast with purely theoretical discussion. It calls for a close and patient establishment and examination of experimental, statistical and theoretical data, with a view to the formulation of comparatively simple design codes. These must avoid highly elaborate calculations and yet allow of reasonably correct assessment of intricate factors such as are created by the interactions of columns and beams through their connexions.

In its first report in 1932, the Committee disclosed its plans for systematic research, and recommended a code of practice incorporating up-to-date ideas and effecting economies in design. The code was a tentative effort at order and scarcely pretended to elucidate fully the problems concerned with the contractions of the structural elements. In this second report now issued, the Committee shows itself mainly engaged on these difficulties, and presents a remarkable collection of data and ideas relevant thereto

The usual assumption of completely rigid joints in built structures is only a simplification in calculation. It is recognised to be untrue. Some slip must occur at the connexions. The amount of this has been variously assumed for different purposes, but the Committee rightly deals with this question as one of the vital matters at issue The procedure followed has included investigation of the actual behaviour of connexions in full-scale experimental frames; the measurement of stresses in actual building frames before and after encasement in concrete; and an elaborate investigation of various forms of connexions and bolted joints

The experimental building frame was described in the first report. Dr. Baker, the technical officer to the Committee, now presents an interesting report on the results obtained for single-bay and two-bay arrangements, and discloses the surprising fact that quite slight differences of some kind in the connexions result in considerable variations in the stresses. Even with the use of the experimental refinement of a 'torque control' spanner for the joint bolts, discrepancies of a fair amount still existed Dr Faber deals with the tests and stresses in the steel frame structure at the Museum of Practical Geology, South Kensington, while Prof Batho and others discuss very fully experimental and analytical work on joints, bolts and connexions This last includes interesting and unusual work on bolt stresses and torque control in tightening. In fact the 'torque control' spanner is a surprising but noticeable and recurring feature of this report, and we may be allowed to wonder whether it will ultimately appear in building codes

The report also contains an excellent discussion on analytical methods by Dr Baker, including a treatment of mechanical analysis by models There is a concluding section of distinct importance on the strength of welded joints carried out for the Committee at the National Physical Laboratory and containing valuable results on the hitherto somewhat neglected aspect of fatigue strength. Altogether this report contains a vast amount of vital information It requires careful study, but the study will be well repaid

Electrokinetic Phenomena

Electrokinetic Phenomena and their Application to Biology and Medicine By Dr Harold A Abramson (American Chemical Society, Monograph Series, No 66) Pp 331 (New York: The Chemical Catalog Co, Inc., 1934) 7.50 dollars.

DR ABRAMSON'S monograph is planned partly on historical principles. In his first chapter he records the discovery of the phenomena classified by colloid chemists as capillary-electrical or electrokinetic, namely, the flow of fluid past a wall and the movement of a small particle caused by an electric current, and the converse phenomena, referred to as the flow potential, set up by the movement of liquids through porous diaphragms. In the second chapter, he describes the correlation between these phenomena and potentials at surfaces, worked out by Helmholtz and by Smoluchowski. More recent work, based on the conception that an ion atmosphere is present at the surface, due to Gouy and to Debye and Hückel, is recorded in the fourth chapter.

Experimental methods, including the apparatus used by Abramson in his studies of particles coated with proteins, are described in the second chapter, and the remaining chapters describe experiments on proteins, inert surfaces, inorganic and organic surfaces, gases, blood cells, bacteria and related systems From some points of view, an arrangement in which the simpler systems are dealt with first might be preferable, but there are certain advantages in considering the proteins first In the words of the author, "Although the proteins are complicated from the point of view of their chemical structure, from another aspect they are less complicated than any other surface to be discussed here, for the reason that the average electric charge Q per dissolved molecule can be determined by a thermodynamic method This charge so determined, can serve as a reference with which the validity of the theories of electrokinesis can be tested".

In the account of the thermodynamic method, evidence is recorded in favour of the view that protein chlorides are fully ionised in dilute solutions, and it is concluded that the charge can be calculated from the acid or base bound, as measured by the hydrogen electrode It is shown that such titration curves can be superposed on curves showing the relationship between mobility and pH value, recorded by Tiselius and by other investigators. These observations support the thesis that, in some respects at least, the protein surfaces are particularly favourable for experimental investigations It may be noted that the observations of Freundlich on inorganic surfaces showed no correlation between electrokinetic and thermodynamic potentials.

In a field complicated by many unknown factors, the discovery of simple relationships is of great value, but in a review of the work it is perhaps advisable to point out that there are certain qualifications of the conclusions drawn by Abramson, which have not been stated in his book In the first place, the amount of acid or base combined with a protein at a given pH is not independent of the amount of neutral salt present, as shown by Sørensen, Linderstrøm-Lang and Lund.

In the second place, it may be noted that since the publication of this book, additional evidence concerning the validity of the author's method has been obtained by comparing measurements of titration curves and valences calculated from membrane potentials, and it would appear that the results calculated from titration curves may be subject to appreciable corrections

Although differences of opinion may be held on certain points, there is no doubt that Dr. Abramson's book should advance the study of electrokinetic phenomena, as he has brought together recent work on the physical theory of the double layer, and experimental data obtained in the fields of chemistry, biology and medicine

Short Notices

Structural Design in Steel By Prof Thomas Clark Shedd. Pp ix+560 (New York John Wiley and Sons, Inc.; London Chapman and Hall, Ltd, 1934) 25*s*. net

The professor of structural engineering in the University of Illinois, recognising the impossibility of adequately covering the whole field of structural design in a single volume, has confined his attention to the fundamental principles of steel structures, and has produced an eminently practical manual, interspersed with numerous worked-out examples of calculations, which will be of considerable assistance to the draughtsman, the designing engineer and the student.

Commencing with an introductory chapter of a general character, the book goes on to discuss structural types and framework, the design of beams and girders, tension and compression members, and connexions. Then follow two chapters dealing with the design of structures as a whole one on buildings, primarily of the industrial type, and the other on bridges, both roadway and railway. Both chapters include detailed sets of illustrative calculations of a practical character Since fusion welding is now widely used as a means of jointing, and is not so adequately standardised as the older forms, the author has discussed the subject in a special chapter. Three appendixes, covering general specifications in design, based on standard American practice, form a suitable conclusion to the volume, which is clearly and excellently produced, particularly as regards the numerous diagrams and sheet calculations. The illustrations include a number of photographic views of structures in the United States B. C.

Food and Health. By Prof. Henry C. Sherman Pp x+296. (New York. The Macmillan Co, 1934) 10*s*. 6*d*. net.

Prof H. C. **Sherman**, the author of several scientific books on food and nutrition, has now written a short popular account. A clear description of the caloric requirements of adults and children is summarised in a useful table. Regarding the daily amount of protein, about which there has been so much controversy, Sherman concludes, from direct experimental data, that 44 gm. a day suffices for an adult; for children relatively more, at the figure of 10–15 per cent of the calories. The nutritional responsibilities assigned to the proteins belong rather to the mineral elements and vitamins. The chapters on the vitamins are short. The optimal amounts of each vitamin are four or five times those found as minimal. There are tables, needing corrections, showing the distribution of the vitamins in foods.

A chief feature of the book is the discussion of the supply of mineral salts. Every human being, says Sherman, is born calcium-poor, but iron-rich. The intake of calcium and also of phosphorus must therefore be relatively greater than that of other body-building foods, the daily amounts are given. Attention to mineral salts and vitamins will more surely lead to buoyant as distinguished from merely passable health. A long list of diets shows how the low protein consumption with high calcium and phosphorus (mainly from milk, of which a quart a day is recommended for children) and ample vitamins can be secured The book merits every attention.

The Human Gyroscope: a Consideration of the Gyroscopic Rotation of Earth as Mechanism of the Evolution of Terrestrial Living Forms. Explaining the Phenomenon of Sex: its Origin and Development and its Significance in the Evolutionary Process By Arabella Kenealy. Pp. v+313+16 plates. (London. John Bale, Sons and Danielsson, Ltd, 1934.) 12*s*. 6*d*. net.

Miss Kenealy attempts to show that Newton and not Einstein is right; that Einstein's theory contains no creative principle Her predominant idea is that the development of biologic forms is due to the gyroscopic influence of rotation, acting by way of what she terms the "Great Potter's Wheel of Evolution". She maintains her thesis with a bewildering mass of evidence from many sources, but few of the conclusions she arrives at by skilful argument will bear critical examination While respecting her convictions and impressed by the advocacy of her case, most scientific readers will remain unconvinced.

Aircraft Progress and Development By Capt P. H Sumner Pp. xiv+295 (London: Crosby Lockwood and Son, 1935) 25*s*. net

This volume claims to be "a world picture of progress in Aviation" If the author had confined himself to that conception it would have been an interesting book of the historical record type, that should find a place in every library collection directed toward that end. The illustrations and their descriptive matter are exceptionally complete, and must be the result of a very considerable labour in collecting and collating them The pictures themselves are discreetly chosen and well reproduced The book fails badly when it attempts to give scientific and technical explanations in too small a compass. Compression of technical statements has led the author into both ambiguities and errors.

Geschichte der physiologischen Chemie. Von Dr. Fritz Lieben. Pp. ix+743. (Leipzig und Wien: Franz Deuticke, 1935.) 20 gold marks.

This is a somewhat lengthy historical account of the development of the subject between, or common to, chemistry and physiology, which is now called biochemistry. The story is told at first in connexion with individuals; later it has relation to function and to individual chemical groups. Few will find the leisure to read so long a work, but the author and subject indexes make reference to particular problems easy.

The Geological Survey and Museum

THE new building for the Geological Survey and Museum which has been erected on the west side of Exhibition Road, South Kensington, London, S.W.7, stands in a middle position between the Victoria and Albert Museum, the Science Museum and the British Museum (Natural History) The site which it occupies is part of the ground acquired by the Royal Commissioners of the 1851 Exhibition, and was chosen for this purpose by the Bell Committee (1912). The new Museum (Fig. 1) is linked to the Science Museum by a series of corridors over an arched gateway; at some future time, the Natural History Museum may be extended to the east, and the new buildings will probably join up with the Geological Survey and Museum on its south side.

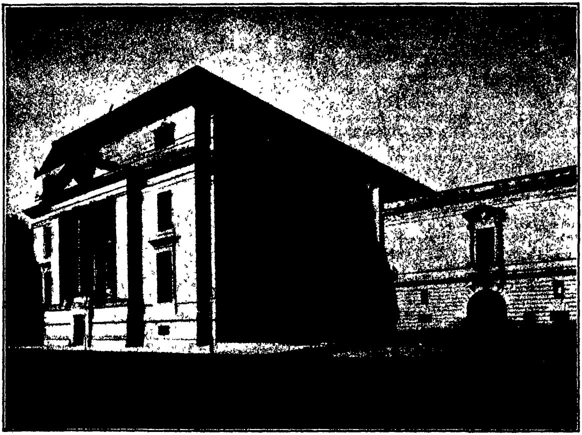

FIG. 1 Geological Survey and Museum, South Kensington.

The building was designed by Mr. John H. Markham, of H.M. Office of Works. Its eastern front, facing Exhibition Road, is of classical design, with a Corinthian colonnade, and has been described by competent judges as one of the most successful recent classical buildings in London. The front archway and part of the north side is of Portland stone, but the rest of the building is of brick with stone sills and courses The shape is a simple rectangle 312 feet long by 100 feet wide and 95 feet high. The Museum occupies the front part of the building while at the rear are the Survey offices, laboratories and library.

Large, metal-framed windows occupy almost the whole of the sides of the building, and in order to secure as much light as possible the amount of dead wall has been severely cut down. The result is that the interior is very well lighted. The general arrangement is that of a central court or well, forty feet wide, lighted from above by a glazed, arched roof, and side galleries, thirty feet wide, lighted by the windows in the walls. The exhibition space comprises a main floor and two galleries, and there are large staircases at each end of the Museum. The galleries are supported on rectangular steel pillars, and the whole building is steel framed, with concrete floors; it is as nearly fireproof as possible. In the Museum there are no partitions, separating the interior into rooms, but the whole structure is open. The

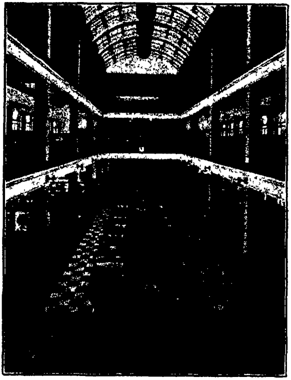

FIG 2. General view of interior, showing the central court and two exhibition galleries

entrance hall and eastern staircase are lined with polished marbles, but in the rest of the building there has been no attempt at decoration, and the architect has relied principally on proportion and symmetry to obtain his effects.

The transfer of the collections from the old Museum in Jermyn Street was completed by the end of October 1934, and the old Museum is now being demolished. The Geological Survey and Offices have been occupied, and the library has been open to the public since November. Considerable progress has been made in the work of arranging the exhibits, and when the new Museum is opened on July 3 by H.R.H. The Duke of York, it will be found that all the floors are covered with displays, which are practically entirely new and totally different from those which were shown in the Jermyn Street Museum.

The main floor (Fig. 2) has been devoted to an exhibition of the introductory principles of geology with the object of interesting the general public who have no special knowledge of the science. A very fine display of gems and semi-precious stones is placed in the centre court. To avoid the disturbing effect of reflections from the roof, the glazed cases have curved tops: they are also provided with artificial illumination. Such minerals as diamond, ruby, sapphire, emerald, topaz, zircon, peridot and lapis lazuli are shown on one side, and on the other onyx, agate, jasper, opal, chalcedony, labradorite and adularia.

The side spaces under the galleries are divided up into bays by means of vertical screens about seven feet high. These screens are covered with photographs showing scenes of geological interest. Each bay illustrates a subject, such as glaciers, earthquakes, volcanoes, marine deposits, river action, rock structure, weathering, the action of plants or the origin of coal. In the table cases a very complete series of specimens, fully labelled, provides examples, mostly of British origin. Each table case also has a medial screen with coloured sketch maps, sections and diagrams. The principle followed has been not to show too many specimens, but to see that all are as typical as possible and to explain their meaning fully and clearly. On this floor also there is a group of dioramas representing picturesque scenes of geological significance, such as the Needles and Alum Bay (Isle of Wight), Edinburgh as seen from Braid Hills, the Avon Gorge (Bristol), Lulworth Cove, Cheddar Cave and Vesuvius (in eruption). It is intended that on this floor the exhibits will interest and attract visitors who have no special knowledge of geology.

In the first gallery, the object aimed at is to

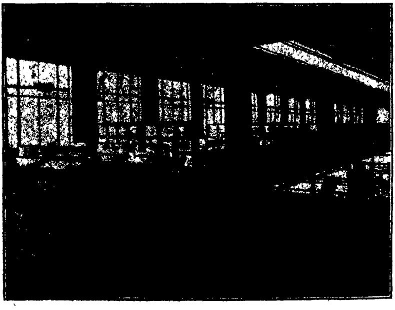

FIG 3. East end of first gallery, showing division by screens carrying photographs.

show the geology of Great Britain For this purpose the country has been divided into areas or regions that have a definite geological and also geographical identity Examples are London and Thames Valley, the Weald of Kent, Devon and Cornwall, South Wales, North Wales, Hampshire Basin, Northern Highlands of Scotland, Central Valley of Scotland Each region is fully illustrated with maps, photographs, sections, rocks, fossils and minerals A special descriptive handbook of each province is being written by an expert geologist who knows the district thoroughly

In the second gallery, the exhibits are intended to explain the origin of the principal metals and the economic application of geology. In the table cases are selected specimens of the ores of iron, lead, zinc, copper, manganese, etc , and also a full exposition of useful non-metallic minerals such as talc, gypsum, china clay, rock salt In special cases there is a large series of British building stones, and such subjects as roadstones, slates, cements, brick clays and asphalts will also have space assigned to them

One of the most important features of this Museum is the accommodation provided for research material and for investigators who wish to work on the Survey's collections. In the top of the Museum there is a third gallery (not visible from the main floor) with about 16,000 feet of floor space, excellently lighted. This is to be reserved entirely for cabinets containing those specimens of minerals, rocks and fossils that are of special interest and importance, and likely to be consulted by scientific experts There is also in the basement of the Museum a large store containing drawers filled with material of less importance which requires to be preserved not for its inherent interest but rather as a record on which statements in the Survey memoirs are founded

The new Museum and Offices are nearly three times as large as the building formerly occupied The cost of the building was approximately £220,000 The old Museum in Jermyn Street has been let on a building lease by the Commissioners of Crown Lands at a yearly rental of £11,000

Clinical Science within the University

IN the Huxley Lecture delivered at the University of Birmingham on March 14 and published in the *British Medical Journal* of March 30, Sir Thomas Lewis made a strong appeal on behalf of the recognition of clinical science, which may be regarded as an answer to the presidential address of Sir Frederick Gowland Hopkins on "Clinical Medicine and Science", a survey of which appeared in NATURE of December 8, 1934 (p 867). In his address Sir Frederick expressed his conviction that the scope for really controlled experiments applicable to the human body was limited, and he deprecated the growing tendency to distribute the funds provided for medical research in the endowment of the clinic at the expense of biological science, and particularly biophysics and biochemistry.

Sir Thomas Lewis started by quoting with approval the declaration made by Sir James Paget sixty-five years ago, that "clinical science has as good a claim to the name and rights and self-subsistence as any other department of biology" ; but he used the term "clinical science" in a wider sense than Paget, who confined it to researches on living man, by defining it as "the branch of knowledge that centres upon diseased human beings, but which also includes relevant parts of the allied sciences". The field of clinical science therefore should include physiology, morbid anatomy and experimental medicine.

Sir Thomas emphasised the point that clinical science is not identical with clinical medicine and clinical surgery, and drew a distinction between the science and art of medicine ; but he maintains that a university must possess a strong scientific department inspired by direct clinical interests

As regards experimental work, Sir Thomas declared that every remedy employed to-day is the result of direct experiment on man, as is best exemplified by vaccination, antiseptic surgery and general anæsthesia Only safe and beneficial experiments are justifiable, and no experiments should be carried out except with the patient's consent. In Sir Thomas's opinion, too many experiments have been and are still being performed , a reduction in their number, and their conduct on a stricter, safer and more productive basis are desirable.

The first requirement of a university department of clinical science is an out-patient department and an in-patient service sufficient to supply ample material for research and teaching, the size of the departments to be decided partly by local conditions and partly by the activities of the professor and his assistants. While admitting that clinical science is essentially a laboratory science, Sir Thomas does not think that the laboratory should be a place reserved for animals. On the contrary, he maintained that laboratories for the examination of patients as well as of animals should be close to the clinical services, and even directly attached to the ward or out-patient department

Although many valuable discoveries may still be anticipated from those actively engaged in the practice of medicine and surgery, Sir Thomas expressed his conviction that in many directions advances may more readily come from men who are able to give their whole time to research, unhampered by routine duties Appointments for clinical research are therefore required, and no more suitable place for such appointments could be found than within a university, where persons engaged in research would enjoy the stimulus derived from teaching and find a congenial atmosphere.

Sir Thomas then passed on to the subject of the medical education of to-day, in which, as is generally agreed, he holds there are grave defects The curriculum is overloaded not only by the preliminary sciences, including anatomy, physiology and general pathology, but also on the clinical side

The plan suggested by Sir Thomas Lewis as a remedy is as follows There should be a first course consisting of the outlines of human anatomy and physiology, with special stress laid on what is immediately applicable to the study of disease The second course, which would not be compulsory for all medical students but would be suitable to a science degree or to those who intended to take up physiology, pathology or clinical science as a career, would be one of more advanced physiology. The third or final course would consist partly of general and practical instruction along existing lines, emphasis being laid on all that is essential to general practice The teaching should be mainly concerned with common diseases and remedies of proved value and ready application The outlines of clinical science should be included in this course, which would be taken by all medical students, but higher examinations would be held by the Royal Colleges and possibly by the universities, and there might be room for a university degree in clinical science for those who proposed to adopt an academic career

As to the final stage of the student's preparation for medical practice, Sir Thomas granted that the best teacher is the man in active practice, who not only understands disease and its treatment in detail but is also able to manage sick people and their friends These accomplishments, however, do not qualify the teacher for the post of university professor in clinical science, whose duties should rather be to deal with the principles and problems of clinical science, and with the patients only to exemplify specific points The former would include the causes of disease, the principles of hereditary transmission of human diseases, the reaction of man to his environment, physical injuries and chemical poisons, the meaning and effects of infection, the significance of sexual, racial and other predispositions to disease, and the origin of new growths in man

In conclusion, Sir Thomas repeated that it is largely within the power of the universities to establish clinical science on the same basis as the allied sciences of physiology and pathology, as distinct from the practical art of medicine.

British Chemical Abstracts

ALMOST exactly eight years ago, the appearance of the first annual index volume, covering the whole of the abstracts in pure and applied chemistry prepared and published under the direction of the Bureau of Chemical Abstracts during 1926, afforded us an opportunity of referring appreciatively to a scheme which has since proved a remarkably successful co-operative enterprise.

The Chemical Society, which since 1871 had undertaken the task of supplying abstracts of papers dealing with pure, physical, inorganic, organic, analytical, mineralogical and biological chemistry, and the Society of Chemical Industry, which had similarly surveyed applied chemistry since 1882, had for many years maintained mutually helpful contact between their respective abstracting organisations; in 1924, however, these two Societies united in establishing the Bureau of Chemical Abstracts, charging the new body with the task of controlling both the preparation and the publication of abstracts in all branches of pure and applied chemistry, and of securing such unification as might prove practicable By the end of 1925 their efforts had been so far successful that consent had been secured to a common format for the two sections, known as British Chemical Abstracts *A* and *B*, respectively, a considerable amount of overlapping material which had previously appeared in somewhat different forms in both sections was eliminated, and the publication of an annual index envisaging the whole range of pure and applied chemistry was undertaken A few, of course, shook their heads disapprovingly at this breach with tradition, and there was some regret—admittedly largely sentimental—at the disappearance of the familiar octavo format, but experience has amply demonstrated the wisdom of the decisions then taken, and, moreover, both American and French chemical abstract publications have since joined the ranks of the 'double column quartos'.

The organisation set up by the Bureau immediately on its establishment had by that time proved to be operating smoothly and efficiently, and the editor, specialist assistant editors, abstractors and indexer settled down to a task of annually increasing magnitude with the firm intention of making *British Chemical Abstracts* the world's best journal of its kind While there is no means of taking the exact measure of their success, there can be little doubt that, despite the need to trim canvas on occasion the better to ride out financial storms, the Bureau and its staff have provided the English-speaking world with an abstract journal which for accuracy, conciseness, promptitude, relevance and catholicity can fairly claim a place certainly not less honourable than that of any other such journal in any language.

During the past five years, there has been proceeding, concurrently with, and independently of, the preparation of the annual joint indexes, work which has now borne fruit in the completion of a collective index covering the period 1923–32*. This publication, which so far as the Chemical Society is concerned is a continuation of a series of collective indexes dating from 1841, and so far as the Society of Chemical Industry is concerned includes the abstracts published independently in that journal in 1923, is a quarto production of some 2,100 pages referring to authors and 1,766 pages referring to subjects; it has been estimated that the number of entries must considerably exceed half a million In order to ensure homogeneity it was found necessary to re-index the abstracts in applied chemistry published before 1926, for in the corresponding annual indexes a somewhat different system had been employed. Moreover, the varying spelling of countless Russian, Indian and Japanese authors' names has been standardised so far as possible, although in some cases the decision has necessarily been purely arbitrary; for although the transliteration of Russian characters is consistent when carried out according to the Bureau's scheme, the frequency with which Russian authors publish in other languages leads at times to their names being transliterated almost out of recognition. Such complications and obscurities as might arise from changes in nomenclature during the period under review, from inadequate identification of authors by their surnames alone, and from the massive entries attributable to the largest industrial firms, have been foreseen and avoided so far as is possible.

In the 'author index', series papers by the same author or authors are collected under one main title, with the years and pages placed after the sub-titles at the end of the entry. The general arrangement of the entries is described in the explanatory notes The volume contains a greatly extended list of radicals, whilst a new and welcome feature is the chart indicating the numbering of positions in ring systems

Could scientific achievement be measured in terms of the weight and volume of an index, there would be ample cause for satisfaction on the part of even the most diligent among the workers in this ten-year period. But the mounting figures which record increases in the number of chemical abstracts published annually still reflect a rapid rate of increase in the volume of new material which finds its way into the periodical and patent literature. Figures, of course, can be made to prove almost anything; but an increase from 25,500 in 1932, the last year of the decade, to 29,400 published in 1934 is perhaps sufficient evidence for the assumption that the production of decennial indexes in future will be an even heavier task The corresponding annual indexes—that for 1934 has just been issued—occupy 578 and 692 pages, respectively.

Provocative, or perhaps merely vacuous, statements regarding the desirability of calling a halt in the publication of chemical literature are still heard; such retrogression is clearly impossible; but on the other hand the desirability of brevity and precision in scientific publications cannot be too insistently urged So far as abstracts play a part in maintaining the march of progress, we can profitably repeat what we have said before that since the rate of advance in any branch of knowledge so largely depends on an adequate acquaintance with the experimental results and theoretical views forming the starting point of any new research, the efficiency of the abstracting and indexing service is a matter which closely concerns every investigator, teacher and student. The success attained by the Bureau of Chemical Abstracts is a demonstration of what can be done when interested parties pool their resources, and it should encourage co-operation over an even wider field.

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* Collective Index of British Chemical Abstracts. (A) Pure Chemistry and (B) Applied Chemistry, 1923–1932, including the Abstracts published with the *Journal of the Chemical Society* and the *Journal of the Society of Chemical Industry*, during 1923–1925 Part 1: Index of Authors. A—K. Pp. 1092. L—Z. Pp. 1093–2101. Part 2: Index of Subjects. Pp. 1766. (London: Bureau of Chemical Abstracts, 1935) £8.

Obituary

Sir Robert Blair

We deeply regret to record the death, which occurred on June 10, of Sir Robert Blair, Education Officer of the London County Council from 1902 until 1924. Born at Wigtown in 1859, he became a pupil teacher at the Garlieston Public School and later went to the University of Edinburgh, where he took his degree in 1880. He joined Aske's Hatcham school in 1882 and, while teaching, secured the London B.Sc. degree. There followed appointments as head of the Cheltenham School of Science and Technical Institute, Inspector of Science and Art, and Assistant Secretary for Technical Education (in Ireland). In 1904 he was appointed to the London County Council. Among the honours which came to him, in addition to his knighthood, were the Order of the Crown from the King of the Belgians, the LL.D. from his old University, an honorary fellowship of the Royal Society of Arts, and a fellowship of King's College, London. He was president of the Association of Directors and Secretaries for Education in 1914, and president of the Educational Science Section of the British Association in 1920.

It was in London that Sir Robert Blair performed the great tasks which made him famous as an educational administrator. Under his direction the present education system was shaped. In particular, the new organisation called for by the Education Act of 1918 gave him a great opportunity of demonstrating his powers of organisation.

Sir Robert's special interest in technical education was well known, and it was continued and deepened after his retirement. Appointed as the British Association's representative on the Emmott Committee of Enquiry into the Relationship of Technical Education to Industry, he became a member of the executive committee responsible for preparing the report and, following the death of Lord Emmott, carried out the duties of chairman.

Sir Robert's vision of the future was broad, and it was ever present in his work. "Life," he said, "has been extended. The engineer, the chemist and the medical officer have broadened the basis, protected our food supply, and safeguarded the public health . . . Science has given us a new era." That was his attitude, and it goes far to explain his success as an administrator.

Prof. W. E. Soothill

The death of the Rev. W. E. Soothill, professor of Chinese in the University of Oxford, which took place on May 13 at Oxford at the age of seventy-four years, will be widely regretted.

William Edward Soothill was born at Halifax, and after a short term in a solicitor's office became a missionary. He went out to the Wenchow district of China in 1882, and within a short period had acquired a knowledge of Chinese which won the respect of Chinese savants. He became exceedingly active in the promotion of teaching and training institutions and of preaching stations. He also translated the New Testament into Wenchowese, and made a translation into English of the Analects of Confucius. The scene of these early labours is commemorated in "A Mission in China". This narrative, however, did not appear until 1907, the year in which the scope of his educational activities was much enlarged by his appointment as president of the Imperial University of Shansi, newly founded by Timothy Richard. His success there encouraged him in the endeavour to promote a university for the whole of China; but his plans, when in course of active preparation by a committee at Hankow of which he was chairman, were interrupted by the revolution and the outbreak of war.

Soothill's services to China in England and France during the War were recognised by the award of two Chinese decorations. In 1920 he was appointed to the chair of Chinese at Oxford. By this time it was recognised that he was the foremost Sinologist of the day. He became a member of the governing body of the School of Oriental Studies in London, and in 1926 was a member of the delegation to China in reference to the settlement of the Boxer indemnities.

Prof. Soothill was the author of a number of scholarly works on China and Chinese, including "The Student's Chinese Dictionary", "The Three Religions of China", "China and the West", "A Short History of China" and "The Lotus of the Wonderful Law". His daughter is the widow of Sir Alexander Hosie, and is also known as a writer of authority on aspects of Chinese life and culture.

Mr. D. N. Dunlop, O.B.E.

Mr. D. N. Dunlop died on May 30 after a short illness. He was born in Ayrshire, Scotland, in 1868, and served his engineering apprenticeship in Glasgow. After experience with the Westinghouse Company, he became in 1911 the first organising secretary of the British Electrical and Allied Manufacturers' Association (B.E.A.M.A.) and in 1917 his post was renamed Director. He held this position until his death. He took an active part in the foundation of the Electrical Research Association and of the Electrical Development Association.

While Dunlop rendered great and enduring services to the British electrical industry, it is chiefly as the founder of the World Power Conference that he will be remembered in wider circles. Not many years after the War, he conceived the idea that engineers and men of science, whose inventions had been so powerful in destruction, should lend their great talents in the rebuilding of the world. He succeeded in enlisting the support of the Council of the B.E.A.M.A., which ensured the necessary financial backing, and on June 30, 1924, the Prince of Wales opened the first World Power Conference.

Dunlop, from the beginning, had the hope that a permanent organisation would grow out of the first World Power Conference. But it was not his intention himself to make a proposal to this end. In the event, all the countries which participated united to demand that the work begun in 1924 should continue and, as is well known, during the past eleven years the second plenary World Power Conference has been held in Berlin and sectional meetings in Basle, London, Barcelona, Tokyo and the Scandinavian capitals, while the Chemical Engineering Congress of the World Power Conference will take place in London next year.

The World Power Conference has, under Dunlop's guidance, become a highly important international body with forty-nine member-countries and a central office in London. But from the beginning he envisaged something much more than a technical organisation of the producers and consumers of power and fuel. He saw in it the meeting-place between scientific workers and engineers on one hand, statesmen and economists on the other. He placed an even higher value upon the opportunities for personal encounters which the World Power Conference provided than upon the great technical results already enshrined in more than forty volumes of transactions.

WE regret to announce the following deaths:

Colonel W. C. Blackett, past president of the Institution of Mining Engineers and of the North of England Institute of Mining and Metallurgical Engineers, on June 13, aged seventy-five years.

Mr. W. S. Franks, who, for twenty-five years, was in charge of the Brockhurst Observatory, East Grinstead, known for his work on the colours of stars, on June 19, aged eighty-four years.

News and Views

Award of the Albert Medal to Sir Robert Hadfield, Bt., F.R.S.

THE Albert Medal for 1935 of the Royal Society of Arts has been awarded, with the approval of the president, H.R.H. the Duke of Connaught, to Sir Robert Hadfield "for his Researches in Metallurgy and his Services to the Steel Industry". The Society's Albert Medal, its premier award, is given annually "for distinguished merit in promoting Arts, Manufactures or Commerce". It commemorates the work for the Society of the Prince Consort, who for eighteen years was its president, and to whom the success of the Great Exhibition of 1851, organised by the Society, was largely due. Awards are made irrespective of nationality, and the list of former recipients of the Medal includes the leading men of science, inventors and other benefactors of humanity. Seventy-five awards have now been made, of which nineteen have been to workers outside Great Britain. The first Albert Medal (1864) went to Sir Rowland Hill, for his reform of the postal system of Great Britain. In 1866, Michael Faraday was the medallist, and later recipients have included forty-one ordinary fellows of the Royal Society and nine foreign members. The other metallurgists of the distinguished company which Sir Robert Hadfield now joins are Bessemer, Siemens, John Percy and Sir Isaac Lowthian Bell.

The Abbotsbury Swannery

HOWEVER patriotic and air-minded we may be, however much alive to the urgent necessity governing the general policy of the Air Ministry at this particular moment, the proposal to set up an aerial machine-gun practice ground in the very middle of the "Fleet" alongside Chesil Beach in Dorset, was bound to call forth the protests which it has already done in consequence of the near neighbourhood of the famous Abbotsbury Swannery. Not unnaturally, those informed members of the community who are well qualified to realise the very regrettable consequences which are bound to result, have attempted to make their influence felt. One of the most important would be the all too frequent disturbance of the swans on their very localised winter feeding ground. Founded in all probability in 1044 by the monks of the Benedictine Abbey of Abbotsbury, Lord Ilchester has stated recently in *The Times* (June 18) that the first references to the swannery which he has been able to discover are to be found in the Court Rolls of the Manor, 16, Richard II (A.D. 1393), and there are many others, including disputes about ownership in the time of Queen Elizabeth. The actual number of swans forming this *perfectly natural colony of wild birds* varies around eight hundred. It is, therefore, not only historically and biologically of very considerable interest, but also in all probability it is the largest swannery in Europe at the present moment. Associated with it there are other birds and plants. It has been stated in defence of the proposed target practice ground that birds soon get used to aeroplanes and noise. That is no doubt true; but is not the point. The vital objection is the ploughing up of their feeding ground by missiles. If the choice of such a locality is really a matter of urgent necessity, it seems altogether deplorable.

Maintenance of Life in Isolated Animal Organs

To study the functions of an organ under well-controlled conditions frequently necessitates its removal from the body in order to avoid influences reaching it from other tissues, which it may not be easy to control. It is difficult, however, to maintain the isolated organ in a condition even approximating the normal. One of the greatest advances was made by Knowlton and Starling in 1912, with the introduction of the 'heart-lung preparation'. This consists of the lungs—artificially ventilated—and heart of an animal, and pumps oxygenated defibrinated blood round an artificial circuit, which may include one or more different organs. the latter are thus perfused with blood under conditions approximating the normal The preparation, however, only lasts for a few hours. It is reported in *The Times* of June 22 that Dr. Alexis Carrel and Colonel C A. Lindbergh, the well-known American airman, have devised, at the Rockefeller Institute for Medical Research, New York, an apparatus by means of which isolated organs can be kept alive, even growing, for prolonged periods

IN this apparatus, the organs are removed aseptically from the dead animal together with surrounding tissues, arteries, veins, nerves and lymph vessels: all are kept constantly protected with gauze pads soaked in Dakin's solution The perfusion fluid consists of blood serum or of solutions containing protein-split products: a small amount of phenol red is added to act as an indicator of the metabolic activity of the organ or of the occurrence of bacterial infection The air supply, kept in contact with the perfusion fluid, contains 40 per cent oxygen and 3–4 per cent carbon dioxide. The apparatus is kept in an incubator at body temperature. The organs so far kept alive in this manner have included thyroid gland, ovary, adrenal, spleen, heart and kidney, obtained from adult fowls or cats, an ovary actually grew in size and weight by the addition of new cells and tissues It is hoped to use the method for the study of the production of hormones by the glands of internal secretion, for the isolation of substances essential to the growth, differentiation and functional activity of these glands and for the discovery of the laws of association of organs. It is also hoped to study diseases in isolated human organs. The success of the method depends principally upon maintaining complete freedom from bacterial infection, and secondly on the use of suitable nutrient fluids, difficulties which Carrel and Lindbergh appear to have overcome.

Antiquities from Tell Duweir, Palestine, 1934-35

THE annual exhibition of antiquities from Tell Duweir (Lachish), Palestine, found by the Wellcome Archæological Research Expedition to the Near East under the leadership of Mr. J. L. Starkey in the course of the excavations of 1934–35, opened on June 24 at the Wellcome Research Institution, 183–193 Euston Road, London, N.W 1 The objects exhibited again illustrate details of culture in the various periods represented on the site, beginning with the extensive prehistoric settlements of the copper and bronze ages and ending with the later Jewish kingdom, when the city suffered the successive onslaughts of Sennacherib and Nebuchadnezzar. Further light is thrown upon the early cave dwellers, and the possible line of development of the localised art reminiscent of Tell el-Amarna, of which evidence was found last year, is suggested by a bone inlay in the form of a head, which seems to be a copy of an ivory original. Another interesting find is an Iron Age burial, which included among its grave furniture a short-handled iron fork with three long prongs. It is reasonable to conjecture that this implement served the priest to extract joints from the offerings-bin of the sanctuary discovered last year. Culturally and historically, however, the outstanding finds are a further example of the early script, resembling that from Sinai, which adds three characters to those known from last year's find, and a series of letters on ostraka, dating from shortly before the fall of the city, now to be identified with certainty as Lachish This discovery, long eagerly awaited, alone makes the excavation notable An instructive commentary on the work of the expedition is afforded by a cast of the bas-relief of the siege of Lachish, now in the British Museum, which, coloured and skilfully flood-lit, can be seen in full detail for the first time. The exhibition is open daily from 11 a m until 5 p m, and on certain evenings until 8 p m, until July 27 A lecture on "The Lachish Letters found at Tell Duweir" will be given by Dr Harry Torczyner, professor of Hebrew philology in the University of Jerusalem, on Tuesday, July 9 at 5 p.m. Admission to the exhibition and lecture is free by ticket.

The Quetta Earthquake

A CORRESPONDENT of *The Times* (June 24) gives some interesting details about the great earthquake of May 31. The zone of destruction extends from Surab in Kalat State to a few miles north of Quetta Its length is 130 miles and its width 15–20 miles Even within this area, its effects were variable. In some parts, they spread over the whole width, in others, they were confined to a narrow line, some villages being untouched, while others were destroyed Quetta lies in an upland valley, 5,500 ft above the sea, in which earthquakes are rather frequent. The recent shock, however, differed from its predecessors Though the loss of life was much greater, road and rail communications were not damaged, trees, lamp-posts and most of the telegraph poles remained standing, and electric current was available from the first hour of the shock. The great destruction in Quetta City is traced to the poor quality of the buildings, the erection of earthquake-proof houses having been generally neglected. In the areas of excessive damage, the few buildings that were earthquake-proof remained intact, and not even their chimneys fell.

Tercentenary of the Muséum National d'Histoire Naturelle

THE tercentenary of the Muséum National d'Histoire Naturelle in Paris has been celebrated during the past week, and included a *séance solennelle* on June 25 in the presence of the President of the Republic. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, was the principal delegate from Great Britain, and delivered an address in the name of the foreign delegates who were present. In view of the number of delegations attending the gathering, it was decided to select representative men of science to deliver addresses; Sir Arthur Hill spoke on behalf of the foreign delegates and also as a botanist, M Lacroix, a geologist, represented the Institut de France, and M. Caullery, a zoologist, acted on behalf of the French delegates

Loss of the *Dana*

It is reported in *The Times* of June 24 that the Danish Government's scientific research ship *Dana* sank on June 23 in the North Sea, sixty miles west of Ringkjöbing, Jutland, after a collision with a German trawler. The director of the vessel's scientific work, Dr. Å V. Tåning, and the crew were saved The *Dana* was well known to men of science and others through the work of the late Prof. Johannes Schmidt, director of the Physiological Department of the Carlsberg Laboratory, Copenhagen, on the migration of eels It may be remembered that the oceanographical expedition of the *Dana* in 1928–30 was described in an article by Prof Johannes Schmidt in Nature of March 21, 1931, p 444 and March 28, p 487, which included a reproduction of a photograph of the *Dana*.

Floodlighting for the Royal Silver Jubilee

The floodlighting of London and of many provincial cities has generally been favourably received by the public. The use of coloured light for buildings like the London County Hall and Hampton Court Palace has been severely criticised. The latter development was partly due to the invention of gaseous electric lamps which provide an economical method of producing coloured lights In the *Illuminating Engineer* of June, P Good reviews the Royal Jubilee electric lighting He points out that the floodlighting of a building produces a visual impression which is quite unrelated to the daylight picture and should be so judged. If it has produced a satisfactory impression, it can be justified on artistic grounds. The Horse Guards Parade, illuminated by white light in 1931, was illuminated by violet light in 1935. Although one paper described it at the Jubilee as "a magic castle of palest violet", yet to most people it looked like a temporary structure of plaster and not worthy to be compared with its appearance on the earlier occasion when illuminated by white light. The electrical industry has shouldered the burden of the cost of providing permanent installations at Buckingham Palace, the Horse Guards Parade, the National Gallery and 'Big Ben'. Other interests are paying the cost of the permanent floodlighting of St. Paul's Cathedral. The floodlighting of public gardens has been universally praised. St. James's Park at night illuminated by 300 gas floodlights was a great attraction When the development of the buildings on the south side of the Thames is completed, it is to be hoped that arrangement will be made for floodlighting and that commercial advertisements will be excluded.

Electric Supply Tariffs in Great Britain

A serious hindrance to the rapid development of public electric supply in Great Britain is the great inequality in the charges made for electricity in many neighbouring districts. In a paper on public supply tariffs by J. A. Sumner read to the Institution of Electrical Engineers on February 28, it is concluded, after a careful study of methods of lowering the costs of distribution, that it is not unreasonable to forecast that electricity will be available within the next few years to all consumers at a rate of 0·5*d*. per unit Mr Sumner begins by comparing the costs per kilowatt of a private supply station with that of a public supply. Statistics for the case when Diesel engines are used for the private supply prove that it is the more expensive It appears that many undertakings are selling electricity for power purposes at a lower rate than is required to compete with the real costs of running private plant Hence in some cases the domestic consumer is penalised unfairly. It is pointed out that the distinction between 'urban' and 'rural' supply is sometimes unnecessary, as in many cases the capital expenditure for dwellings near the mains is much the same in the two cases. The analysis of the statistics proves that the merging of electricity areas into much larger single districts than at present is necessary for the reasonable standardisation of tariffs It is possible in this way to balance the inevitable deficit of a newly-developed area against the surplus from the older areas By this means a uniform tariff can be kept throughout each single large administrative district.

Applications of Photo-electric Control

The *G.E C. Journal* (General Electric Company) of February gives an interesting review of electrical progress and development in 1934. Many useful devices are described. Aerodrome obstruction and boundary lights must be switched on when daylight is poor and when darkness approaches in the evening. It is essential that the pilots see the boundary of the aerodrome and any obstructions in the vicinity. The photo-cell has been successfully applied to the control of these lights. At Croydon Airport the switching on of the obstruction light is controlled by a photo-cell amplifier. Another useful application of photo-cells is to control the speed of escalators. The wear and tear of escalators like those in the underground railways of London which are in continuous use is extremely heavy; and renewals and repairs are expensive and, owing to the restricted space, are difficult to carry out. It is desirable to keep the speed low during slack periods at the less-frequented stations when no one is on the escalator. At the entrance to the stairway, a suitable lamp is installed to shine across the footway on to a photo-cell similarly mounted on the other side, just below the handrail. When this beam is interrupted by the entrance of a passenger, the stairway is speeded up in several stages so that the passenger feels no shock, and the escalator continues to run at a high speed until the passenger has time to reach the top. This is attained by a time delay device using a radio valve. If other passengers come on to the stairway before the last one reaches the top, the time delay device resets, so that the high speed continues until the last passenger gets to the top, after which the low speed comes into operation.

Early English Railways

IT is known that in the archives of various foreign countries there are documents of interest to students of the history of technology, but seldom is any of this material published. One such document, however, has recently formed the subject of a paper by Mr. P. Zabarinskiy published in vol 4 of the "Archives for the History of Science and Technology" The paper itself is in Russian, but with it is the letter of William Vaughan dated, London, June 14, 1804, and addressed to his Excellency Vice-Admiral Chichagoff, minister of the marine at St Petersburgh William Vaughan (1752–1850) was a director of the Royal Exchange Assurance Corporation, London, and was much interested in canals and railways and docks Railways, he said, were common in England and Wales for the conveyance of coals, limestone, ore and such things, and in the London Docks, in which he evidently was particularly interested, railroads and waggons were used in the excavations Experiments were apparently made at the Docks and in one of these, he said, "In six days of 12 hours, 25 men filled, 24 boys drove and 24 horses conveyed, 3650 cubic yards of earth to the distance of 400 yards and returned the waggons empty" Vaughan described clearly the turntables used on the banks of the Thames, gave estimates of the cost of removing material and made some remarks on the use of railways in Russia.

Work of the Rockefeller Foundation

THE Rockefeller Foundation's report for 1933 presents a tale of vast and varied activities, for the financing of which it had, in pursuance of its mission "to aid in the process of the rationalisation of life", made itself wholly or partially responsible Its policy in relation to the pressing social problems of the day is guided by the principle that it "can neither remain indifferent to them nor relinquish the support of the fundamentals on which in the long run the control of man's destiny depends". In medical and natural sciences, emphasis has been laid on the problem of mental health and the advancement of the rapidly evolving modern science of man, in the social sciences, on the problem of economic structure and process, international relations and community organisation and planning; and in the humanities, on the encouragement of international cultural understanding and the preservation and interpretation of American culture Early in the year a sum of a million and a half dollars was set aside for emergency grants for work in connexion with the 'new deal' programmes. Contributions were also made as an emergency measure towards the salaries of eminent scholars displaced for political reasons in Europe and 'adopted' by universities in Europe and the United States. Appropriations during the year totalled about ten million dollars. Among the larger appropriations in the field of the social sciences were: Brookings Institution for Economic Studies, 250,000 dollars; Institute of Economic and Social Research, Paris, 350,000 dollars; League of Nations, 275,000 dollars; National Bureau of Economic Research, New York, 225,000 dollars, social science research aids, 150,000 dollars, Social Science Research Council, New York City, 265,000 dollars.

Scientific Horticulture

THE third Year book of the Horticultural Education Association appears under the new title "Scientific Horticulture". It is longer than in previous years, its contents cover a wider field, and go far to justify the change of heading. The presidential address of the Association is by Dr T Wallace, and deals with "Science and Fruit-growing", mainly from a historical point of view. Many of the papers in the volume were delivered at a revision course in horticulture arranged by the University of Reading in September, 1934 The practical nature of the lectures of this course is at once apparent—they deal with the highest-grade modern processes in vegetable culture, glasshouse work and bulb-growing, together with descriptions of diseases and pests. They are incorporated as Bulletin 47 of the University of Reading Articles contributed specially for the year-book include "Commercial Horticulture in Northern Ireland" by W. J. Megaw and E. E Skillman, "Fruit-tree Spraying Equipment" by J Turnbull, "The R.H.S. Apple and Pear Conference, 1934" by N. B. Bagenal and R T. Pearl, "Selection of Soils for Dessert Apple Growing" by B. S Furneaux, "Twenty-one Years' Fruit Research at East Malling" by R T. Pearl and R. Hart", "Waste Products in Horticulture, their Utilisation as Humus" by Sir Alfred Howard, and "Research at Rothamsted of Importance in Horticulture" by Miss M. D. Glynne and H V. Garner. The volume entirely justifies its name, and is a great credit to Mr R T Pearl, its honorary editor One has the feeling, however, that the bias is on the practical side, and that the newer scientific principles which most gardeners have yet to learn—such as photoperiod, seed stratification and control, plant sterility and the conditions affecting vegetative regeneration—are not expounded. The school garden, the primary stage in horticultural education, receives no notice whatever.

Over-population in America's Deer Herds

IN the Yellowstone National Park, the two great herds of wapati or 'elk' now comprise about 30,000 individuals, and in the northern area the drought-reduced pastures have accentuated a long-standing problem of over-population (Science Service, Washington, D C.). The fundamental cause of the food scarcity which has resulted is the inevitable restriction of the natural emigrations of the herds, for outside the northern boundary of the Park, the Yellowstone Valley is occupied by cattle ranches These make an impassable barrier and confine the deer permanently to a quite inadequate portion of what is naturally only their winter range. Over-grazing has altered the vegetation for the worse, most of the nutritious native grasses have been killed out, and their place taken by a weed grass, fox-tail, which apart from its low nutritive value, pierces the gums and permits the growth of a fungus producing the disease of 'lump-jaw'. Two solutions have been proposed: one that about half the total number of deer should be captured, transferred to a central slaughtering station outside the Park, and killed and distributed to destitute Indians, the other that the captured animals should be set free in areas of Montana where they could be hunted by sportsmen. The second plan is that favoured by National Park officers, but they insist that whatever plan is adopted, it must be carried out promptly, because of the daily increasing seriousness of the emergency.

Meteorology in India

THE report on the administration of the Meteorological Department of the Government of India in 1933–34 has for frontispiece a very good photograph of a tornado which visited Peshawar on April 5, 1933, probably the first photograph to be obtained of this phenomenon in India. The Department has again been hampered by the heavy curtailment of expenditure initiated in 1932, and has nevertheless had to face increased demands for meteorological information on the part of air mail services. It was necessary, therefore, simply to dispense with additional forecasting centres and other facilities demanded by the circumstances, and to carry on with what is described as a skeletal meteorological organisation along each air route. Between April 1, 1933 and March 31, 1934, nearly six thousand weather reports and forecasts were issued to aviators by the departmental forecasting centres at Karachi, Calcutta and Poona and the Royal Air Force centres at Quetta and Peshawar, which are under the technical though not the administrative control of the Department. The report quotes remarks made in a discussion at the Royal Geographical Society of an account of the Ruttledge Mount Everest Expedition that are a strong tribute to the help that can be given to mountain expeditions by local forecasting centres in India. In this case, the Expedition was in touch with Dr. Sen of the Calcutta office for the supply of special forecasts. Scepticism of the value of forecasts that are based largely on observing stations at a comparatively low level was quickly seen to be unjustified, particularly when an abnormally early monsoon was successfully predicted. Among the many activities of the Department, it may be noted that the recently established branch of agricultural meteorology carried on special researches into matters affecting the growth of crops, and that some of the results have already been published.

The Engineer as Planner

IN an article entitled "The Engineer as Planner" reprinted by *Engineering Inspection* of January 1935, Dr. Victor Cofman emphasises the fact that the important factor in the solution of economic and social problems is the application of the spirit and methods of engineering and science to the wider field of human relations, not the particular person who does it. While everyone agrees that the planning of production is the obvious duty of the engineer, opinions are divided as to how far the engineer can help in the social and economic fields, and it is often pointed out that eminent engineers and men of science do not show particular perspicacity or vision when dealing with social problems. It is essential that those who will have to consider social questions must have a full knowledge of the pertinent facts, and it may be necessary under existing conditions to have a team consisting of sociologists and economists, practical men acquainted with the problems, working together with engineers and men of science acquainted with the methods of science. The opponents of planning take it for granted that planning is synonymous with greater restriction upon individual freedom, but one may plan for freedom and peace just as one may plan for oppression and war. The true opposition is not between planning and liberty, but between arbitrary interference and liberty.

Bibliography of Seismology

THE last quarterly number of this useful work, which is edited by Mr. E. A. Hodgson and published by the Dominion Observatory, Ottawa, completes the twelfth volume and the list of memoirs for 1934. The total number of memoirs referred to during the year is 506, some of them in title only, but many of the more important accompanied by a brief abstract. It is satisfactory to notice that the number of collaborators is increasing, and that new countries are being added to the list, though there is still no representative for Great Britain. The subject-index for the year under more than fifty headings adds greatly to the value of the Bibliography.

The Planetarium

ACCORDING to an article in *The Times* of June 22, accommodation for a planetarium is being included in the plans for rebuilding the centre portion of the Science Museum, South Kensington. It is stated that Germany already has thirteen planetaria, America four, Italy two and Holland, Sweden, Austria and the U.S.S.R. one each. Such an instrument enables celestial bodies to be shown as bright objects on the inside of a large darkened dome, and by means of elaborate mechanism their movements can be demonstrated. The method thus marks a great advance on the orrery, in which the positions and movements of bodies in the solar system are represented in a mechanical model. It will be recalled that the first Zeiss planetarium, erected at Munich, was described and illustrated in NATURE of December 27, 1924, p. 937.

Astronomical Phenomena during July

VENUS is a conspicuous object in the evening sky. The planet reaches its greatest eastern elongation on June 30, when the stellar magnitude is $-4\cdot0^m$, but the planet will continue to increase in brilliance throughout July, the stellar magnitude being $-4\cdot2^m$ on July 31. As both Mars and Jupiter are conspicuous in the evening sky, one can get a very good idea of the ecliptic stretching across the sky, especially when the moon is visible Mars, the magnitude of which is $+0{\cdot}3^m$ at the beginning of July, will decline in brightness by three tenths of a magnitude during the month The planet will move towards Jupiter, which is near α Libræ Jupiter's magnitudes are $-1{\cdot}9^m$ and $-1{\cdot}7^m$ at the beginning and end of the month respectively. Saturn's Right Ascension is 22^h49^m, about eight hours behind Jupiter and 11^h36^m behind Venus at the end of the month Saturn's declination being 9° S, it will not be possible to see these four of the five naked eye planets in the same sky from stations north of terrestrial latitude 40° N. during July. Venus is in conjunction with Neptune on July 25 at 06^h G.M.T, Venus being 2·6° S. There is a partial eclipse of the sun, partly visible at Greenwich, on June 30 The eclipse begins at 20^h07^m G M T. and fourteen per cent of the disc will be covered at sunset A total eclipse of the moon on July 16 is also partly visible at Greenwich. The moon enters the penumbra on July 16 at 02^h15^m and leaves the penumbra on July 16 at 07^h43^m, the eclipse being visible on the Atlantic Ocean generally A further partial eclipse of the sun takes place on July 30; this will be invisible at Greenwich.

Announcements

THE medal of the Society of Chemical Industry has been awarded to Dr. E. F Armstrong, "for conspicuous services to chemistry". The presentation will be made during the annual meeting and conference of the Society in Glasgow on July 1–6, and Dr. Armstrong will deliver his medallist address on Thursday, July 4, on "The Past, the Present and the Future". Previous recipients of the Society's medal, which is one of the highest awards in the chemical industry, include many well-known men whose work forms the basis of modern science. Notable amongst these are the names of Mr. C. F. Cross, a pioneer of the artificial silk industry, Sir James Dewar, Sir Henry Roscoe, Sir William Crookes, Sir Joseph Swan, Dr. Ludwig Mond, Sir W. H. Perkin, and Mr. John Glover, who was the first to receive the award.

MR. WALTER ELLIOT, Minister for Agriculture and Fisheries, has been elected a fellow of the Royal Society under the special statute which permits the election of "persons who have rendered conspicuous service to the cause of Science, or are such that their election would be of signal benefit to the Society".

MIRZA MUHAMMAD KHAN QAZVINI, a distinguished Iranian savant, has been elected an honorary member of the Royal Asiatic Society in recognition of his many valuable contributions to the cultural history of his country.

THE annual general meeting of the Dechema (Deutsche Gesellschaft für chemisches Apparatewesen E.V.) will be held on July 3–5 at Koenigsberg, together with the general meeting of the Verein Deutscher Chemiker. The general topic of the meeting will be "German Materials in Chemical Engineering".

UNDER the auspices of the Royal Society for the Protection of Birds, the University of London Animal Welfare Society, and the Society for the Preservation of the Fauna of the Empire, an evening meeting will be held at the Royal Geographical Society, Kensington Gore, London, S W.7, on July 2 at 8.30, when Capt C. W R. Knight will exhibit his new film of South African animals, entitled, "African Adventure" The chair will be taken by the Right Hon the Earl of Athlone Admission will be by invitation only, and applications should be made to the R.S P B, 82, Victoria Street, London, S W 1.

THE public health services in Mexico are being reorganised as follows: inspectors of food, water, drainage, epidemics, immigrants and prostitutes are being appointed, co-operative medico-sanitary units are being formed, a sanitary unit has been created in the department of irrigation, and sanitary brigades are being organised for carrying out vaccination against small-pox and typhoid fever

A FRENCH Medical Aeronautic Association has recently been founded in Paris under the presidency of M Emile Strohl It will form a centre for technical and medical documentation, enabling medical men to collect physiological and pathological data connected with aeronautics and flight at high altitudes It will also facilitate more direct relations between medical men and engineers and technicians for the elaboration of plans concerned with the hygiene of passengers and the transport of the sick and wounded Further information can be obtained from the general secretary, M. Robert Charlet, 95 rue Jouffroy, Paris, 17ᵉ.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A tutor in mathematics in Westminster Training College, Horseferry Road, London, S.W 1—The Principal (July 4) A resident lecturer in geography in the Saltley Training College for Schoolmasters, Birmingham—The Principal (July 5). An assistant teacher in the Mechanical and Marine Engineering Department of the Liverpool City Technical College—The Director of Education, 14, Sir Thomas Street, Liverpool, 1 (July 5). An assistant lecturer in mechanical engineering in the Manchester Municipal College of Technology—The Registrar (July 9) An assistant in botany in the University of Aberdeen—The Secretary (July 12). A lecturer in pharmacology in the University of Sheffield—The Registrar (July 12). A resident tutor in geography in Borough Road College, Isleworth, Middlesex—The Principal (July 17). A demonstrator in physics in the University of Leeds—The Registrar (July 22) A lecturer in electrical engineering in the Royal Technical College, Salford—The Director of Education, Education Office, Salford. Research assistants to the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester. An assistant lecturer in agricultural biology in Seale-Hayne Agricultural College, Newton Abbot, Devon—The Secretary.

Letters to the Editor

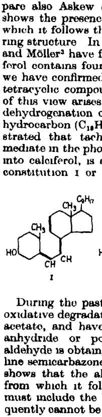
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1078.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Ring Structure of Calciferol

ALTHOUGH calciferol has been shown to be isomeric with ergosterol ($C_{28}H_{44}O$), comparatively little information has hitherto been adduced concerning the detailed structure of this vitamin According to Windaus, Linsert, Luttringhaus and Weidlich[1] (compare also Askew *et alia*[2]) perbenzoic acid titration shows the presence of three ethenoid linkages, from which it follows that calciferol contains a tetracyclic ring structure In contrast to this observation, Kuhn and Möller[3] have found by hydrogenation that calciferol contains four ethenoid linkages, a result which we have confirmed Calciferol cannot therefore be a tetracyclic compound Further evidence in support of this view arises from the work of Lettré[4], who on dehydrogenation of calciferol failed to obtain Diel's hydrocarbon ($C_{18}H_{16}$). Again, this author has demonstrated that tachysterol, which is a direct intermediate in the photochemical conversion of ergosterol into calciferol, is also tricyclic, probably having the constitution I or II



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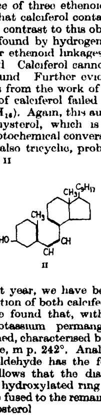
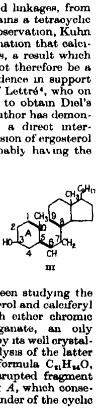


II



III

During the past year, we have been studying the oxidative degradation of both calciferol and calciferyl acetate, and have found that, with either chromic anhydride or potassium permanganate, an oily aldehyde is obtained, characterised by its well crystalline semicarbazone, m p. 242°. Analysis of the latter shows that the aldehyde has the formula $C_{21}H_{34}O$, from which it follows that the disrupted fragment must include the hydroxylated ring *A*, which consequently cannot be fused to the remainder of the cyclic system as in ergosterol

Our analytical data for the semicarbazone appear to preclude the formula $C_{21}H_{32}O$ for the aldehyde, indicating that one of the ethenoid linkages of calciferol is present in ring *A* On this evidence, formula III is suggested for the vitamin, the formation of the aldehyde $C_{21}H_{34}O$ occurring by simple rupture of the $\Delta^{5:6}$ ethylene linkage. It must be observed that the location of the ethylene linkages at $\Delta^{1,10}$ and $\Delta^{8,9}$ is provisional and remains to be confirmed

I M HEILBRON
K. M. SAMANT.
F. S SPRING.

University,
Manchester.

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[1] *Ann.*, 492, 226, 1932.
[2] *Proc Roy Soc*, B, 109, 340; 1931
[3] *Z angew. Chem.*, 47, 145, 1934
[4] *Ann.*, 511, 280, 1934

Colorimetric Estimation of Œstrin in the Urine of Non-Pregnant Women

LAST year we reported the details of a method by which it is possible to determine the œstrone and œstriol content of human pregnancy urine colorimetrically with a reasonable degree of accuracy[1]. Since the publication of our paper we have received numerous inquiries as to whether the method can be used for the determination of the œstrin content of urine of non-pregnant women As this question seems to be one of some general interest, and since in our paper we made no mention of the possibility of using our method for this purpose, we wish to take this opportunity of mentioning briefly our views on the matter

We have made numerous attempts to estimate the œstrone and œstriol in the urine of non-pregnant women by our colorimetric method, but so far the results have been far from encouraging. Owing to the relatively small amounts of œstrin present it is necessary to carry out the colour reaction in a much larger quantity of extract than we use in the case of pregnancy urines, and hence the colour reaction is carried out in fractions which contain a relatively much higher proportion of non-œstrogenic phenolic substances The final colour obtained in such tests is a dirty brown instead of a clear pink as is obtained with pregnancy urine extracts. This colour can, of course, be analysed with the Lovibond tintometer, but we do not feel at all confident that the red component of the brown colour can be accepted as a true measure of the œstrin present

We feel, therefore, that our method as described for pregnancy urine is of little value for the estimation of the much smaller amounts of œstrin present in the urine of non-pregnant women, and we cannot advise its use for this purpose

G. F. MARRIAN.
S. L. COHEN.

Department of Biochemistry,
University of Toronto.

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[1] *Biochem J*, 28, 1603; 1934

Radio-Transmission of Cosmic Ray Data from the Stratosphere

ON April 1, 1935, an apparatus recording cosmic rays by the coincidence method and transmitting the signals by Moltchanoff's radio method, ascended to the stratosphere from the Institute of Aerology at Slootsk (25 km from Leningrad). The construction of the apparatus and observations with it obtained in an aeroplane flight have already been described[1].

The coincidences were recorded by a relay, which switched on the anode circuit of the radio-oscillator. The radio-signals made in this way were received and counted at the earth's surface by three observers.

Besides the coincidences, the apparatus transmitted at more or less regular intervals the total number of discharges produced in one of the two counters. For this purpose, switchings were effected in the amplifier by means of a barograph about every 5 minutes. The number of switchings indicated the pressure data

The apparatus functioned for 58 minutes Judging by the data of the three observers—which were in fairly good accord—the number of the coincidences produced by the vertical beam of cosmic rays increased with the increase in altitude as follows up to the altitude of 5 km by 9 times, up to 7 km. by 18 times, up to 9 km by 27 times At greater heights the number of coincidences ceased to increase and the last observation, obtained at the altitude of 12·2 km, even showed a slight fall

The number of discharges produced in one counter increased up to the altitude of 6 km by 3 5 times, up to 7·5 km by 6 times. At greater altitudes (up to 13·6 km.) the number of discharges became too great to be counted, but the intervals were used for tuning the receiver

The apparatus ceased to function at the altitude of 13 6 km as soon as the balloons started descending after one of them had burst

It seems that the method described may be used for the study of cosmic rays at great altitudes, especially in thinly populated localities (near the equator and in the arctic region), where finding self-recording apparatus would present considerable difficulty.

In conclusion, I wish to express my sincere thanks to Prof. P Moltchanoff for his continued interest, his many helpful suggestions and for the organisation of the flight

S. VERNOFF.

Institute of Aerology,
Slootsk,
and
State Radium Institute,
Leningrad.
June 3.

[1] *Phys Rev*, **46**, 822, 1934.

The Phosphorescence Process as Revealed by the Luminescence from Solid Nitrogen

SOME years ago it was found by me that a number of bands appearing in the afterglow of solidified nitrogen were due to forbidden transitions from metastable, molecular electronic states.

The appearance of bands from forbidden transitions in the crystalline state was explained by the fact that they only appear in the α-form of nitrogen where the molecular axes are fixed in the lattice, while they are absent in the β-form where the molecules rotate[1].

This result would suggest that the rate of decay of the afterglow was determined by the probability for the occurrence of the forbidden transition. This view, however, could not be upheld because the rate of decay sometimes is very slow and does not follow an exponential law.

In order to explain the phosphorescent property (afterglow) of nitrogen, it was assumed[1] that the bombarding rays produced a dissociation of the molecules into atoms which might be neutral or ionised.

Energies corresponding to the elementary process of the chemical reaction were transferred to the molecules in such a way that they were brought into an excited state with electrons raised to higher levels. In this way the phosphorescence appears to be closely related to chemi-luminescence. The difference is mainly that in the case of phosphorescence the reacting substances have first to be produced by means of radiating quanta

This view has recently obtained an interesting confirmation by the study of the ε-system (Vegard-bands) from solid nitrogen, which some years ago was shown by me to result from the forbidden electronic transition from the $A(^3\Sigma)$ level to the normal state $X(^1\Sigma)$ of the nitrogen molecule.

For the upper state A (bottom state of the first positive group) we know at least 15 vibrational levels. For the ε-system no bands are known starting from a vibrational level (A) with quantum numbers n' greater than 7. A few bands were observed for $n' = 7$, and for all values of n' equal to or smaller than 6 a large number of bands were observed

This sudden break in the vibrational states of the upper ε-level was first explained by means of the potential curves for the upper and lower state and by a reasoning similar to that underlying the Franck-Condon theory of intensity distribution of vibrational bands

Recently, more accurate determinations of the potential functions have shown that this explanation can scarcely be maintained. The abrupt limit of the upper vibrational states, however, can be accounted for, if we assume that the ε system—which also remains in the afterglow—is excited through recombination of normal nitrogen atoms formed during the ray-bombardment

The dissociation energy of nitrogen has been determined by Herzberg and Sponer[2], and recently the value $D(N_2) = 7{\cdot}345$ volts was given by Büttenbender and Herzberg[3].

The energy necessary to excite the vibrational states $n' = 7$ and $n' = 8$ of the A-level is 7·29 and 7·45 volts respectively. The dissociation energy $D(N_2)$ is just sufficient to excite the $n' = 7$ state, but too small to excite the level $n' = 8$.

The assumption that the ε-system afterglow is due to a recombination of nitrogen atoms (chemical reaction) thus accounts for the fact that ε-bands occur for $n' = 7$, but not for n' larger than 7

L VEGARD

Physical Institute,
University, Oslo
May 25

[1] L Vegard, *Ann Phys*, **6**, 487, 1930
[2] G Herzberg and H Sponer, *Z phys Chem*, **26**, 1; 1934
[3] G Büttenbender and G Herzberg, *Ann Phys*, **21**, 577, 1934.

The Solution, by the Method of Association, of Problems in Inverse Probability

IN his review[1] of a book by Sir Arthur Eddington, Prof. Dingle criticises Sir Arthur's solution of a certain problem in inverse probability. Prof Dingle proposes a second, simpler, and analogous, although different, problem: If A and D each speak the truth once in three times independently, and A says that D lies, what is the probability that D speaks the truth? He argues that from our knowledge of D, the probability is 1/3, while from our knowledge of A it is 2/3, and hence that neither for his problem nor for Eddington's can there be any consistent, correct solution. Yet Prof. Dingle's problem can be regarded as a problem in statistical association, and admits of one, and only one, solution.

Consider the universe of N events, each consisting of D's either lying or telling the truth, and of A's either affirming or denying that D has lied. By the data, the frequency of D's lying must be $2N/3$, and of his telling the truth, $N/3$. Also by the data, the frequency of D's lying followed by A's statement that D has lied must be $2N/3$ times $1/3$, and followed by A's denial that D has lied it must be $2N/3$ times $2/3$. Likewise, the frequency of D's telling the truth followed by A's affirming that D lies must be $2N/9$, and followed by A's denying that D has lied it must be $N/9$. The accompanying association table exhibits these frequencies, there are no inconsistencies. Out of the sub-universe $4N/9$ in which A says that D lies, D actually lies $2N/9$ times and tells the truth $2N/9$ times, and hence the desired probability is $1/2$. It can be nothing else.

	A says that *D* lies	*A* denies that *D* lies	Total
D lies	$2N/9$	$4N/9$	$2N/3$
D tells the truth	$2N/9$	$N/9$	$N/3$
Total	$4N/9$	$5N/9$	N

Whenever the prior probabilities, as here, are known, any straightforward problem in inverse probability can be recast into the form of an association or contingency table, and must lead to a unique solution. But when one tries to cast into the form of a table of association or contingency a problem in inverse probability for which the prior probabilities are unknown, then the ratios between the total frequencies of the 'cause' rows remain capable of arbitrary adjustment, and no unique probability can in general be found for a particular cause of the observed event. It is only when one or more of the class frequencies vanish in the table that any conclusions can be drawn without a knowledge of the prior probabilities, the argument then becoming a conditional syllogism, *modus tollens*. The method of association not only clarifies the solvable problems in inverse probability, but also demonstrates the logical fallacy involved in almost all applications of the method of inverse probability, when the prior probabilities are unknown.

T. E. STERNE.

Harvard College Observatory,
Cambridge, Mass.
May 4.

[1] NATURE, 135, 451, March 23, 1935.

DR. STERNE's statement concerning me, that: "He argues that . . . neither for his problem nor for Eddington's can there be any consistent, correct solution", is not quite accurate. I did not dispute that a combination of the data was possible which would allow of a unique result, but I claimed that such a combination did not yield 'probability' according to any significant meaning of the word. If the square of a man's height be divided by the natural logarithm of his age, and the result called his 'affability', this quality can be uniquely determined, but it gives no indication of the reception he is likely to give us. We can either (*a*) define probability in a purely mathematical way and so obtain a unique solution which may be both consistent and correct (although, in my opinion, Sir Arthur Eddington's solution was neither); or (*b*) refrain from calling meaningless mathematical functions 'probability', and then obtain two solutions to each problem.

I am willing to discuss the correctness of Sir Arthur Eddington's solution or the significance of his implied definition of probability, but to avoid taking up space unnecessarily, I will wait to hear in which, if either, question Dr. Sterne is now interested.

HERBERT DINGLE.

Imperial College of Science,
S.W.7. May 17.

The Breeding Age of the Yellow-bellied Toad, *Bombina variegata variegata*, Linn.

IN view of the scarcity of data on the age at which *Salientia* begin to breed, and an apparently entire lack of information for the above species, it may be of interest to record that I have to-day seen eggs laid by a pair of these toads which were hatched in my terrarium in 1932. The animals are not yet full-grown, the male measuring 35 mm., the female 37 mm., whilst full-grown toads are about 45 mm.

The males had well-developed nuptial pads last summer, and vigorously attempted to mate with females of all ages, but were prevented from securing adult females permanently by the pugnacity of the older males[1]. While I was watching last year, young females always released themselves.

The first sign of sexual behaviour was seen as early as 1933, when an animal only 20 mm. long seized another even smaller, which responded by the typical female release reaction. Behaviour which is sexual in character is not in this species invariably associated with reproduction, as noted for *Bufo bufo* by Hinsche[2], but it is interesting to find this complex behaviour already in existence in very small toads only one year old.

R. MAXWELL SAVAGE.

19 Derwent Avenue,
N.W.7. June 10.

[1] Savage, R. M., "The Spawning, Voice and Sexual Behaviour of *Bombina variegata variegata*, Linn.", *P. Zool. Soc.*, 4, 889–898, 1932.

[2] Hinsche, G., "Über Brunst und Kopulationsreaktionen des *Bufo vulgaris*", *Z. vergl. Physiol.*, 4, 564–606, 1926.

Fossils as Indicators of Continental Drift

MOST geologists will doubtless agree with Sir Arthur Smith Woodward as to the need for caution in the interpretation of some of the fossil evidence which has been regarded as supporting the hypothesis of continental drift[1]. The possibility that fossils referred to the same genus or even the same species may have been developed in different areas (whether from a common or different ancestors) is familiar to those who have been concerned with Mollusca or Brachiopoda, but the implications as regards classification or the value of fossil lists are not so well understood, and Sir Arthur's warning is no doubt timely.

It may be remarked, however, that where, in any system, numbers of similar forms occur in a comparable sequence in widely separated areas, the evidence of a former connexion between the areas is immeasurably stronger; especially is this true where there is a succession of unrelated species belonging to different groups.

These conditions appear to be suitably illustrated in the Upper Carboniferous rocks of western Europe and the eastern States of America, where there is the additional advantage that both flora and non-marine fauna have required practically continuous continental areas for their migrations. As regards the floral succession, in particular, the similarity of the sequences in the two continents has recently been emphasised by Profs. Jongmans and Gothan[2]. Many European species belonging to all the more important Carboniferous genera occur in Pennsylvania, West Virginia and Kansas in substantially the same sequence as that found in Europe, so close is the agreement that a fairly detailed correlation is proposed.

It may be possible to account for these facts by hypotheses other than that of continental drift, but I would suggest that they are of real importance in any discussion of the problem.

A. E. TRUEMAN

Geology Department,
University of Bristol.
June 3.

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[1] NATURE, **135**, 900, June 1, 1935.

[2] W. J. Jongmans und W. Gothan, "Florenfolge und vergleichende Stratigraphie des Karbons der Östlichen Staaten Nord-Amerika's. Vergleich mit West-Europa". Geol. Bureau Heerlen, Jaarverslag over 1933, pp. 17–44, 1934.

PROF. TRUEMAN, who has specially studied Carboniferous stratigraphy, makes an important addition to my brief article. Following Wegener, I merely mentioned that the theory of continental drift might explain the observed distribution of Carboniferous land and fresh-water life in the northern hemisphere. Prof. Trueman rightly emphasises the significance of the identity of succession of this life in widely separated areas. There can, indeed, be no doubt that identity in succession of whole faunas and floras in two distant regions is much more satisfactory proof of former connexion than the apparent identity of single groups to which I chiefly referred.

A. SMITH WOODWARD.

Statistical Aspect of the Production of Primary Lesions by Plant Viruses

MR. BALD points out in NATURE of June 15 (p. 996) that an attempt to fit the equation $y = N(1 - e^{-ax})$ to data obtained by Samuel and Bald[1] meets with poor success, especially at high dilutions. Samuel and Bald plotted the logarithms of their counts against the logarithms of the dilutions and found that at high dilutions the points lay on a straight line with a slope of 0·6. It may be easily shown that the equation predicts a slope of unity. Data published recently by Price[2], Chester[3], Caldwell[4] and Beale[5], give experimental curves with approximately unit slope. This suggests that the discrepancies between Samuel and Bald's experimental counts and values calculated from the equation may in a large part be due to the fact that their data are at variance with other measurements in the literature.

It is true that the equation gives low values at high dilutions, and this was pointed out and a possible explanation offered. It is also true that in this range more plants have to be used to obtain accurate results, since the error is a function of the total number of lesions. The use of log paper for plotting results exaggerates the weight of measurements at high dilutions.

Finally, the sixteen dilution curves fitted to this equation give no indication that its application, at least over a considerable range of dilution, is limited to highly purified virus preparations. Contrary to the idea that only certain cases were chosen, an attempt was made to include all published dilution curves giving data at high enough concentrations to establish the nature of the curve. The lack of concordance between the dilution data reproduced in Mr. Bald's letter and the curves obtained by other workers indicates that Samuel and Bald's data cannot be used to condemn the validity of the equation.

W. J. YOUDEN.

Boyce Thompson Institute,
Yonkers, New York.

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[1] *Ann. App. Biol.*, **20**, 70–99, 1933.

[2] *Contrib. Boyce Thompson Inst.*, **4**, 359–403, 1932.

[3] *Phytopath.*, **24**, 1180–1202, 1934.

[4] *Ann. App. Biol.*, **20**, 100–116, 1933.

[5] *Contrib. Boyce Thompson Inst.*, **7**, 37–53, 1935.

Coagulation of the Blood as a Chain-Reaction

IN studies on the mechanism of the coagulation of blood, I have found that an active principle of coagulation is formed in the process of coagulation—a principle which can be transferred indefinitely into new plasma without decrease in its activity. In one experiment, 30 γ of an active phosphatide[1] was added to a certain amount of chick plasma. About one minute before coagulation took place, another similar portion of plasma was 'inoculated' with 0.03 c.c. of the first plasma, which was still liquid. Before coagulation of the second plasma took place a third portion of plasma was inoculated; then the coagulation time of the second plasma was recorded. Then a fourth portion of plasma was inoculated from the third, and the coagulation time of the third plasma was recorded. Inoculation of a series of plasmas was continued in this way successively until the original amount of active phosphatide added was diluted to 5×10^{-16} γ, and the experiment was discontinued. The clotting time was practically constant through all the passages.

Further experiments showed that the coagulation-active substance formed during the clotting process of blood plasma increases and disappears almost instantaneously at the very moment of coagulation. The formation of the active principle in the plasma occurs shortly after the 'inoculation' rather slowly, but it increases very rapidly until it reaches an explosion-like rate just before the plasma clots. As soon as the coagulation has taken place, the activity of the principle disappears almost completely. The curve plotted for the formation of active substance during the coagulation process has an exponential form.

A theory of blood coagulation as a chain-reaction finds support in our experimental facts. It is still an open question, on which work is proceeding, whether free radicals are produced during this process. As in chain reactions, we have here an initial reaction and a chain interrupting reaction. The latter is indicated by the sudden decrease in activity when the substrate is used up. In our case the chain reaction velocity is exponential, and should belong to such a type as foreseen by Christiansen and Kramers[2] and proved experimentally by Hinshelwood and Grant[3] for the hydrogen-oxygen system. In this kind of chain-reaction more than one active molecule or free radical of the kind which started the reaction may be set free by any of the elementary reactions.

ALBERT FISCHER.

Carlsberg Foundation,
Copenhagen. May 15.

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[1] Fischer, A., and Hecht, E., *Biochem. Z.*, **269**, 115; 1934.

[2] Christiansen, J. A., and Kramers, *Z. phys. Chem.*, **104**, 451; 1923.

[3] Hinshelwood, C. N., and Grant, G. H., *Proc. Roy. Soc.*, A, **141**, 29; 1933.

Oscillations of Hollow Quartz Cylinders

WITH reference to the letter by Ny Tai-Zé and Tsien Ling-Chao published in NATURE of August 11, 1934 (p. 214), it is interesting to note that annular quartz rings cut in a plane perpendicular to the optic axis were investigated by Giebe and Scheibe[1] in 1928, by the luminous resonator method. Such a ring, oscillating in its fundamental longitudinal mode, was also made by Dye, and was afterwards developed to form the primary standard of frequency at the National Physical Laboratory. More recently, similar rings oscillating in an overtone longitudinal mode have been investigated in an attempt to incorporate the most successful features of the different types of quartz oscillators which have been developed to form frequency standards in this and other countries

In the type of ring oscillator now being investigated, the exciting electrodes consist of two brass cylinders around the inner and outer edges of the ring. An overtone circumferential mode of vibration having six nodes is employed. The ring may be mounted rigidly at the nodal points so that movements within the electrodes are completely eliminated By adjustment of the width of the ring, that is, the difference between its internal and external radii, it has been found possible to reduce the temperature coefficient of frequency over a limited range to a few parts in a hundred million, which is a hundred times smaller than the usual coefficient for longitudinal vibrations of quartz The temperature at which the low coefficient is obtained can be adjusted to any desired value

L ESSEN

National Physical Laboratory,
Teddington May 16.

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[1] Giebe and Scheibe, *Elektrische Nachrichten-Technik*, **5**, 81, 1928

Plasticity of Crystals of Sylvine

ATTENTION has frequently been directed to the plasticity of crystals of rocksalt when immersed in water. Some see the cause of the plasticity in the removal of surface layers with their cracks and defects Others suppose that water penetrates the crystal lattice and acts as a lubricant. It is interesting to observe the behaviour of crystals in a state of recent formation from solution or melt For this purpose I have made some experiments with sylvine(KCl).

I find that crystals of sylvine which, like those of rocksalt, are brittle under normal conditions, become plastic after treatment with water At high temperatures (700°–780°) sylvine possesses noticeable plasticity . it is deformed by small loads. The mobility of deformation may be adopted for calculation of the viscosity of the crystals, although variable in its value.

Crystals taken out of the solution in which they are grown and wiped with filter paper are very plastic at first. If exposed to the air without any special drying they become fragile in a few hours.

Sylvine crystallises in the form of parallelepipeds, sheets and fibres ; sometimes also in skeleton forms.

Sheets of 0·1 mm. thickness are so plastic that they can be bent so as to form tubes. Fibres 0·2–0·3 mm. in thickness and up to 10 cm. in length bend under their own weight.

Consequently sylvine crystals on forming either from melt or from solution possess considerable plasticity, and must yield easily to mechanical stresses This may explain the frequent occurrence of bent and twisted crystals

E W ZEHNOWITZER.

Leningrad.

Electrolytic Method for obtaining Bright Copper Surfaces

IT is possible to polish a copper surface electrolytically by making it the anode in an aqueous solution of orthophosphoric acid at high current density (minimum 25 amp./dm ^{2}). This mode of polishing is particularly suitable for metallographic examinations, and has been used for the examination of copper deposits in presence of various colloids.

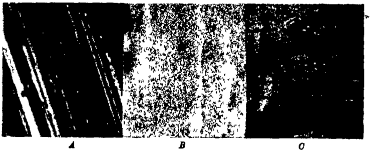

FIG 1 ×400

The specimen is first roughly treated with emery paper, then cleaned cathodically in an alkaline solution and finally inserted for about two or three minutes in an aqueous solution of orthophosphoric acid, 50 per cent by volume of the commercial product, specific gravity 1·71. The current density was maintained at 60 amp./dm.^{2} of the total surface The solution had to be cooled to avoid considerable increase of temperature. Any metallic plate will serve as cathode. Gas being vigorously evolved, a rotating anode helps to get a uniform effect. The microscopic analysis of the surface shows the lines produced by emery polishing (Fig. 1, *A*) to vanish completely (Fig. 1, *B*) and an attack by means of the usual agents gives the image reproduced on Fig 1, *C*. Should this attack be insufficient, the anodic polishing can be repeated for about thirty seconds to obtain a fresh surface ready for another attack. This method is much more rapid and more economical than polishing by alumina.

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Twinning in Alpha Iron

IN a letter to NATURE of June 1, A. B. Greninger reports having observed twinning in alpha iron. Slow cooling through the A_3 temperature produced twins of the banded type, whilst deformation and recrystallisation resulted in twins which were seldom banded. It was shown by me in 1928[1] that certain strained and annealed alpha iron crystals contained twins lying along (112) planes, and furthermore I cited evidence suggesting that twinning in alpha iron might sometimes be associated with twinned gamma iron from which it had cooled. It has also been observed[2,3] that on annealing a deformed single crystal of alpha iron the polygonal aggregate obtained gives pressure figures indicating uniform orientation, and it seems likely that this may also be associated with twinning.

The general importance of annealing twins to the metallurgist has hitherto been the evidence which they afford of the previous history (cold-working and annealing) of the specimen Unfortunately only X-ray methods can be relied upon to detect them with certainty in alpha iron, and now apparently some method of distinguishing between the two processes of origin is required

An interesting practical point may be connected with this twinning behaviour. Mild steel tinplate is said to be more ductile and to have better Erichsen values when cold-rolled and annealed than when hot-rolled and normalised. The former process probably produces a more highly twinned structure, which for crystallographic reasons would tend to deform more easily.

HUGH O'NEILL

L M.S Research Laboratory,
Derby. June 5

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[1] *J Iron and Steel Inst*, 117, 689

[2] H O'Neill, *T A I.M E* (Iron and Steel Div), 229, 1928

[3] L B. Pfeil, Carnegie Mems, *J Iron and Steel Inst*, 153, 1927

Dissociation Energy of the CO Molecule and the Sublimation Heat of Carbon

THE direct experimental values of the sublimation heat L of carbon obtained by several authors[1] lie between 139 and 177 kcal An accurate value can be deduced from the energy of dissociation D_{CO} of CO into normal atoms, since the well-known relations (at 0°K.):

$$\begin{aligned} \text{C}_{\text{diam.}} + \tfrac{1}{2}\text{O}_2 &= \text{CO} + 27{\cdot}6 \text{ kcal.}\\ \text{CO} &= \text{C}(^3P) + \text{O}(^3P) - D_{\text{CO}}\\ \text{C}(^3P)_{\text{gas}} &= \text{C}_{\text{diam}} + L\\ \text{O}(^3P) &= \tfrac{1}{2}\text{O}_2 + 58{\cdot}7 \text{ kcal} \end{aligned}$$

lead to

$$L = D_{\text{CO}} - 86{\cdot}3 \pm 0{\cdot}2 \text{ kcal. } (86{\cdot}3 \text{ kcal.} = 3{\cdot}74 \text{ v.e.}) \qquad (1)$$

The value of D_{CO} was hitherto not exactly known. However, the predissociation in the CO($B^1\Sigma$) level[2] gives the upper limit: $D_{\text{CO}} \leqslant 11{\cdot}07$ v e. We obtain the lower limit in the following way: for the upper level ($A^1\Pi$) of the fourth positive CO bands, which lies 7·99 v.e. above the ground ($X^1\Sigma$) state, 16 vibration levels (2·41 v.e.) are observed, corresponding to $7{\cdot}99 + 2{\cdot}41 = 10{\cdot}40$ v.e. above the ($X^1\Sigma$) state. This value is a lower limit for D_{CO}, if CO ($A^1\Pi$) dissociates into normal atoms. By linear extrapolation (which gives in many cases values which are too high) of vibration levels of the ($A^1\Pi$) state we obtain about 4 v.e. ($v'_{\text{max.}} = 43$), that is 12 v.e. above the ($X^1\Sigma$) state The ($A^1\Pi$) state could be formed only from atoms of equal multiplicity: (*a*) C(^3P) + O(^3P) or (*b*) C(^1D) + O(^1D) or (*c*) C(^1S) + O(^1D), etc. Already the interpretation (*b*) leads to $D_{\text{CO}} \leqslant 8{\cdot}79$ v.e. $= 12 - 3{\cdot}21$ v.e. (3·21 v.e. being the sum of excitation energies of C(^1D) and O(^1D)). According to (1), then $L \leqslant 5{\cdot}05$ v.e. (116 kcal.); this value must be excluded as being beyond the errors of determinations of L (it seems also too near to $L = 113$ kcal. for Fe) Consequently, we must assume that CO($A^1\Pi$) dissociates into non-excited atoms (if it is really a singlet state) and D_{CO} lies between 10·4 v e and 11·07 v.e D_{CO} is certainly much nearer to the upper limit, since at the 16th vibration level the convergence is still not sufficiently advanced. $D_{\text{CO}} = 11$ v e $= 253{\cdot}6$ kcal is probably not in error by more than 0·1 v e. Therefore we obtain $L = 7{\cdot}26$ v e $= 167$ kcal The restriction of the error limits to 0·1 v e. = 2·3 kcal eliminates one of the most important uncertainties inherent at calculations of formation energies of carbon compounds[3].

P GOLDFINGER.
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May 23

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[1] H Kohn and M Guckel, *Z Phys*, 27, 305, 1924 A L Marshall, and F J Norton, *J Amer Chem. Soc*, 55, 431, 1933

[2] D Coster and F Brons, *Physica*, 1, 155 1, 634, 1934 D N Read, *Phys Rev*, 45, 752, 1934 R Schmid and L Gerö, *Z Phys*, 96, 656, 1935

[3] L. Pauling and J Sherman, *J Chem Phys*, 1, 606, 1933 C T. Zahn, *J Chem Phys*, 2, 671, 1934 W Lasareff, *J Phys Chem* (in the press) and *Physica* (in the press). P Goldfinger, W Lasareff and M Letort, *C.R*, 200, 1593, 1935.

IN the letter above, which I had the opportunity of reading in manuscript form, Goldfinger and Lasareff calculate the heat of dissociation of CO on the basis of thermochemical and spectroscopical data and give as the most probable value 11 v.e with a possible error of not more than 0·1 v e I want to direct attention to the fact that this may be independently checked by the results of the investigation by Schmid and Gerö[1], who observed in addition to the known predissociation in the $v = 0$ level of $B^1\Sigma$, occurring at $J = 38$, another predissociation (breakdown of rotational structure) occurring at $J = 18$ of the $v = 1$ level The application of the reasoning of Herzberg[2] to this case shows that the lower limit of the asymptote of the perturbing electronic level is situated only 40 cm.$^{-1}$ below the upper limit, equivalent to 11·062 v.e, and that its real position therefore is $11{\cdot}06 \pm 0{\cdot}005$ v e. This would represent the dissociation energy of CO if the asymptote really corresponds to the dissociation in C(^3P) + O(^3P) The alternative possibility that it would correspond to dissociation into C(^1D) + O(^3P) and that therefore $D_{\text{CO}} = 1{\cdot}105$ v e. will be discussed in detail elsewhere.

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[1] Schmid and Gerö, *Z Phys*, 96, 656, 1935.

[2] Herzberg, *Ann Phys*, 15, 677, 1932. 21, 577; 1935.

Research and the Library

WE are in substantial agreement with the views expressed by Mr. G. E. H. Foxon in NATURE of June 8, except that he has misinterpreted the penultimate paragraph of our original article[1], as reference to it will show that it was not our intention to burke scientific debates The inclusion of these would not be overlooked by an editorial board of the calibre envisaged by us. Our point was that votes of thanks and such superfluous matter or padding should be excised.

On the form of a paper, we feel that the introduction is often unnecessarily lengthy, except in the 'key paper' advocated by us, and ruthless editing could reduce its length in subsequent papers without sacrifice of intelligibility We agree that the incomplete paper could be checked, and our regret is that it does get printed owing to inefficient editing

We are wholly on the side of Mr Foxon on the subject of genuine research and the problem of the young worker who is merely adding professional qualification We feel that should publications adopt our recommendations genuine research would flourish, and the problem of the 'kilograms' of contributed papers be solved, by the printing of good quality material with consequent economy of time, cost and bulk.

J L BERRY
WILFRID BONSER

University of Birmingham

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[1] NATURE, 135, 664, April 27, 1935

Prediction of Earthquakes

As Mr. Broughton Edge reminds us[1], an earthquake is preceded by the building up of stress conditions The most direct way of determining stress is by the observation of strain, and the amounts of strain which have been observed prior to an earthquake have been very large.

The methods of interferometry would permit observation of such strain locally at small expense, and the surface stress throughout a large area might therefore be very readily mapped out and a continuous record made. Such observations could scarcely fail eventually to result in foreknowledge of these disastrous occurrences

F TWYMAN

Adam Hilger, Ltd ,
98 King's Road,
London, N W 1
June 17

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[1] NATURE, 135, 997, June 15, 1935

Points from Foregoing Letters

FURTHER steps towards the elucidation of the chemical structure of vitamin D (calciferol) are reported by Prof I M Heilbron, K M Samant and F S Spring They suggest a three-ring formula and indicate the probable position of the double bonds and of the hydroxyl group

Prof G F Marrian and S L Cohen report that their colorimetric method for the estimation of the sex hormone, œstrin, in human pregnancy urine, is not applicable to the detection of that substance in the urine of non-pregnant women, where it exists in much smaller amounts.

Experiments with a cosmic ray detecting apparatus sending its own radio signals as it ascends into the stratosphere are reported by S. Vernoff The apparatus is likely to be useful in thinly-populated localities where the subsequent finding of self-recording apparatus sent up by unmanned balloons would present considerable difficulties

The Vegard bands in the afterglow or phosphorescence of nitrogen are, according to Prof L Vegard, due to a recombination of nitrogen atoms, derived from molecules dissociated by the bombarding rays. This view links phosphorescence phenomena with chemi-luminescence.

Dr T E Sterne suggests that if the apparently inconsistent problem in inverse probability, recently proposed by Dr. Dingle, is regarded as a problem in association, it is seen to be really self-consistent, and that the method of association reveals the nature of the fallacy involved in the use of inverse probability when the prior probabilities are unknown. Dr. Dingle, while admitting that such a combination, giving a unique result, is possible, claims that it has nothing to do with probability.

Mr. R. Maxwell Savage records that the toad, *Bombina variegata variegata*, has laid eggs in captivity at the age of three years. Males showed vigorous sexual behaviour at two years old, and signs of typical sexual reactions were seen in animals only one year old.

While agreeing with Sir Arthur Smith Woodward's warning that similar fossil animals may have developed independently in widely separated areas and are, therefore, no definite proof of Wegener's continental drift theory, Prof A E Trueman points out that identity of succession of similar forms in comparable sequence in the Upper Carboniferous rocks of western Europe and eastern America does provide strong support for the theory.

An active principle responsible for the coagulation of the blood is described by Dr Albert Fischer The active substance is apparently formed during the clotting process of the blood plasma and disappears almost instantaneously at the very moment of coagulation; it can, however, be transferred indefinitely into new plasma without decrease in its activity.

An improved type of cylindrical quartz oscillator (used in television), with a temperature coefficient of frequency a hundred times less than the usual coefficient for longitudinal vibrations of quartz, is described by L Essen

Prof E W Zehnowitzer finds that crystals of sylvine (KCl), like those of common salt, lose their brittleness after treatment with water. Such crystals recently prepared from a molten state similarly possess considerable plasticity, which may explain the frequent occurrence of bent and twisted crystals

A new, rapid and economical electrolytic method of preparing polished copper surfaces for metallurgical examination is illustrated by P. A. Jacquet. The copper is made the anode in an aqueous solution of orthophosphoric acid, and a high current density is used.

Hugh O'Neill discusses the twinning of crystals of alpha iron, which is soft and magnetic and the chief constituent of wrought iron, as evidence of previous history (cold-working and annealing) of the metal; he recalls his former suggestion that twinning in alpha iron might sometimes be associated with twinned gamma iron (non-magnetic) from which it had cooled.

The heat of sublimation of carbon, a constant used in calculating the energy of formation of carbon compounds, has a value of 167 k.cal. according to calculations by P. Goldfinger and W. Lasareff. They deduce its value from the energy of dissociation of carbon monoxide into normal atoms, as determined by thermochemical and spectroscopical methods.

Research Items

'Diminutive' Flint Implements Diminutive flint implements—to be distinguished both by their form and their cultural associations from the microlith of upper palæolithic and early neolithic age—have been found in pliocene and pleistocene deposits in Suffolk, Lincolnshire and the Thames Valley In describing their characteristics, Messrs J Reid Moir and J. P T Burchell point out (*Antiquaries J* , 15, 2) that on two previous occasions only, so far as they can ascertain, have similar implements been recorded, the first being by M E Pittard in 1908 in the valley of the Rebières, Dordogne, and the second in the account of the implements found with the relics of Peking man in the cave of Chou Kou Tien These diminutive implements do not show the characteristic forms of the microlith, but are rather diminutive forms of the industries with which they have been found in association As regards their age, the specimens now described belong to four different periods, of which the latest is much older than upper Aurignac The earliest of the Suffolk implements are of pliocene age and pre-palæolithic type, coming from the Suffolk bone bed beneath the Red Crag Next comes St. Acheul and early Le Moustier series from the 'Middle Glacial Gravel' (held to be of second Interglacial age) underlying the upper chalky boulder clay Next are implements from the Upper Chalky Boulder Clay ; and lastly those from the Lower Floor of late Le Moustier or early Aurignac age in Bolton and Co 's brickfield, Ipswich The Lincolnshire implements come from the 100 ft and 50 ft raised beaches below the brown boulder clay, and are middle to upper Le Moustier , and those from the Thames Valley come from the base of the 50 ft. terrace of post-Combe rock age, while others may be derived from the Boyn Hill 100 ft. terrace and possibly from the 50 ft terrace of pre-Combe rock age. The maximum length of these flints is two inches and the minimum is ⅜ in. Their purpose seems beyond conjecture

Equatorial Islands of the Pacific. In 1924 the Whippoorwill and Kaimiloa Expeditions of the Bernice P. Bishop Museum, Honolulu, visited the low coral islands lying within six degrees of the equator which, though uninhabited when discovered by Europeans, are supposed to have served as resting places for the Polynesian voyagers in their journeys. The results of the search for archæological remains have been recorded by Mr. Kenneth P. Emory (Bull. 123, Bernice P Bishop Museum). On Howland Island, previously recorded excavations and mounds were examined, the most important being an irregular crescent-shaped pile of coral and shells, 18 ft. long, and a low circular enclosure. On Washington Island no artefacts of local origin have been found ; but ancient stone-wall enclosures appear on the south coast. On Fanning Island an enclosure of dressed stones and a tomb near the cable station were inspected, but no excavation was permitted. The enclosure agrees in structure with Tongan and Tongarevan maraes, but, outside these, has no parallels in Polynesia. Similar stone vault burials are widely distributed in Polynesia and are especially characteristic of Tonga. In Christmas Island all the principal sites, except those on the east coast, were visited. They consist of house sites and platforms, coconut groves and ruins, and graves There is no definite evidence of Polynesian settlement, and two village sites have yielded no artefacts, indicating temporary occupation Petroglyphs are too indefinite to be associated with any particular area The traces of Polynesian visitors belong to different periods and come from various directions Jarvis Island produced no Polynesian ruins or artefacts Three well preserved maraes were found on Malden with smaller maraes and a number of ruins. They resemble strikingly those of Raivavae and suggest an occupation of several generations No archæological remains are reported from Starbuck Island

The Termite Population of a Mound Colony Termites of the species *Eutermes exitiosus*, Hill, form mound nests in parts of Australia, and an attempt has been made to ascertain the total number of individuals inhabiting such a colony In carrying out such an estimation, there has to be taken into account the fact that all the termites living in a particular mound are never present within such a mound at any one time. Messrs F G Holdaway, F. J Gay and T Greaves have recently published an article embodying the results of their investigations of this subject (*J Coun Sci and Ind Res* , Australia, February, 1935) The observation that the number of individuals of the afore-mentioned species present in a given mound is greatest during the cooler months of the year led them to study the population of the mounds during such periods Four mounds, not differing greatly in size, were dug up and their populations calculated by a method of weighing It was estimated that 65–70 per cent of the termites in the mounds were encountered and, on this basis, the actual population was calculated to range from 747,000 to 1,806,500 individuals The proportions of individuals in the most populous mound worked out as 1,561,400 workers, 201,000 soldiers and 44,100 nymphs The size of the mound in question was 3 ft 4 in × 3 ft 5 in × 19 in high

Wing and Halter of *Tipula*. J Zaćwilichowski (*Bull Internat Acad Polonaise Sci Lettres*, 2, Oct -Dec 1934) has investigated the innervation and the sense-organs of the wings of one of the daddy long-legs, *Tipula paludosa*, employing vital staining by rongalite white for the nerve elements He describes the distribution of the sense-hairs, sense-bristles and sense-papillæ on the wing and the three chordotonal organs which are present near the base of the wing He regards the innervation as more primitive than that of any other dipterous wing hitherto described and as indicating that *Tipula* is very nearly related to *Panorpa*, the nerves and sense organs of the wing of which he described in a paper in the same journal in 1933. In a further paper the author describes the results of corresponding investigations by similar methods on the halter of *Tipula paludosa*, on which are sense-hairs of two types, sense-papillæ arranged in five groups, and six chordotonal organs After discussing the distribution of the nerves in the halter and the homologies of the parts of the wing and the halter, he concludes that the halter, in contradistinction to Buddenbrock's view (1919), is to be regarded as a rudimentary wing with a remarkable accumulation of sense organs, in consequence of which it plays a notable part in the sensory life of the fly. On the basis of these morphological investigations the halter has assumed no new function, that is, none foreign to the wing, from which it has arisen. The halter is a transformed hind-wing

Water Requirements of Indian Crop Plants. Following the methods of the American investigators, Briggs and Shantz, Prof B. N Singh and two research students, R. B Singh and K. Singh, have examined the water requirements of fifty-seven species and varieties of cereals, cotton, sugar cane, etc., when grown at the experimental station of the Institute of Agricultural Research, Benares Hindu University (*Proc Indian Acad. Sci.*, 1, No. 9, March 1935). The plants are grown in pots with carefully controlled water supply and, in the end, the total water transpired is divided by the dry weight produced, the roots being included in the yield, as was not done by the American experimenters. The amount of water available in these experiments seemed to control the yield of the varieties; the most efficient varieties, it is concluded, have a relatively short life cycle when the use of water is reduced to a minimum It is suggested that, under Indian conditions, these efficient varieties should be grown so that the number of irrigations might be controlled and thus the cost of production diminished. In their demand for water, sugar cane crops proved most greedy, and then in order came tobacco, cotton, rice, potato Other cereals, wheat, oats, barley, as also linseed, pea and mustard, had a much lower water requirement.

Gondwana Deposits of Brazil. Many new observations on the Gondwana rocks of southern Brazil are recorded in a paper by V. Oppenheim entitled "Rochas Gondwanicas e Geologia do Petroleo do Brasil Meridional" (Min. Agric., Dept. Nac. Prod. Min Bol., No 5. Rio de Janeiro, 1934). The author gives a new stratigraphic scheme along the lines of those of White and Oliveira, recording for the first time the existence of several unconformities within the Santa Catarina System. Especially notable is the one between the Lower and Upper Strada Nova, the lower member considered to be Permian while the upper one, with the pelecypod fauna described by Cowper Reed, is of Upper Triassic age. There seems also to be an unconformity between the Upper Strada Nova and the Rio do Rasto group as well as a local one between the last named group and the Botucatú sandstone. The author regards the Bonito group (lower member of the Tubarão series) as partly glacial, stating that in several localities coal seams are known underlying glacial deposits that seem to be *in situ*. These observations are of great interest because until now all the glacial deposits of Southern Brazil were indiscriminately referred to the Itararé series. It is shown that the tectonic structure of the Paraná Basin corresponds in a general sense to a geo-synclinorium with the character of a 'Graben' between Lat. S. 18° and 24°, and of a monoclinal between Lat. S. 24° and 33°. The internal structure is one of faults *en enchelon* from east to west, intensively developed in successive degrees of small individual throw. The paper is illustrated with more than thirty geological profiles based on field observations and deep boring, and with a geological map to the scale of 1 : 2,750,000 comprising the Brazilian States of Rio Grande do Sul, Santa Catarina, Parana, São Paulo and parts of Minas Geraes, Goiaz and Matto Grosso as well as the neighbouring Republic of Uruguay and parts of Paraguay.

Extraction of Oil from Oil Shales and Torbanites. Great Britain is at the present time importing most of its requirements of petroleum and petroleum products Economically, this position may be sound since there are adequate resources of these commodities for some time to come. Politically, however, such dependency on foreign supplies is dangerous, as was demonstrated during the War. For this reason, attention is being constantly focused on the possibility of obtaining liquid fuel from domestic resources Hydrogenation of coal, tar or creosote is being carefully investigated, also production of liquid fuels by synthesis from carbon monoxide and hydrogen, by fermentation to alcohol vegetable products, by polymerisation of certain hydrocarbons, and extraction of oil from oil shales, sands and torbanites. Messrs. Salermo, Ltd, of 14 Waterloo Place, S.W.1, have done a considerable amount of research in connexion with the last possibility, and have recently issued a technical pamphlet on the subject. A brief account is given of the characteristics of oil shales and torbanites, their distribution and possible origin. From this it becomes apparent that oil-yielding products vary substantially in chemical and physical properties, and it is not possible to specify one plant as adequate for the extraction of oil from all types of material. The firm has, however, by dint of prolonged study of the 'primary variables', namely, rate of heating, temperature and carbonisation and rate of removal of oil vapours and gas, achieved a system of retorting which approximates closely to established principles. The Salermo retort and procéss are clearly described and illustrated in the pamphlet already referred to, and in addition carbonisation results are furnished of representative materials after treatment in this plant.

Volumetric Determination of Copper. The iodometric determination of copper depends on the addition of a soluble iodide which precipitates cuprous iodide and liberates iodine, the latter is titrated with thiosulphate. It is well known that the method has certain difficulties The reaction $2\,CuI_2 = 2\,CuI + I_2$ does not go quite to completion when the iodine is titrated, and some iodine appears to be absorbed by the precipitated cuprous iodide, which is always coloured instead of white at the end point. The addition of potassium thiocyanate with the iodide, which precipitates cuprous thiocyanate instead of iodide, does not give good results, because both iodine and thiocyanogen are liberated simultaneously and react with each other. H. W. Foote and J. E. Vance (*J. Amer. Chem. Soc.*, 57, 845; 1935) obtain better results if the titration with thiosulphate is first carried out to the point when starch is added. After adding starch, the titration is continued nearly to the end point usually observed, when about 2 gm. of ammonium thiocyanate is added for 50 c.c. of solution The blue colour immediately deepens. When the thiocyanate has been dissolved by stirring, the titration is finished. The end point is exceedingly sharp and the precipitate is white instead of slightly brownish, probably because the cuprous iodide is transformed, at least on the surface of the particles, into thiocyanate and the small amount of adsorbed iodine is liberated. Considerable changes in hydrogen ion concentration have no measurable effect on the accuracy. The reaction takes place in stoichiometric proportions within one part in 1,600.

Shock Wave of an Explosion and Rate of Detonation. When an explosive is fired from a borehole with no filling above the charge, it not only emits flame and a considerable volume of gases, but there is also a 'shock' wave transmitted to the surrounding atmosphere. This produces the concussion effect felt in the ear to a varying extent when 'shots' are fired. D. B. Gawthrop has described experiments to show how the shock wave is affected by the rate of detonation (*J. Franklin Inst.*, April). It advances in the air ahead of any forward movement of the gases from the explosive. If in unconfined space it expands spherically in all directions, its velocity diminishing, and it ultimately degenerates into a normal sound wave. The paper describes a research made to determine the velocities of the shock waves sent out by the explosives at widely differing rates of detonation. Definite indications had been previously obtained that the rate of detonation is a factor which affects the safety of the explosives when fired in the presence of firedamp. It was found that with a certain charge the average speed of the shock wave at a distance of 15 cm. from the mouth of the borehole was 1,135 metres per second, but at 135 cm. it was only 350 m.p.s. Quadrupling the weight of the charges, the corresponding speeds were found to have increased to 1,670 and 450 m.p.s. respectively. The experiments made showed that the rate of detonation had no effect on the velocity of the shock wave sent out. As the weight of the charge increases there is a decrease in safety in firedamp, and we now know that there is also an increase in the velocity of the shock wave.

Preservative Treatment of Wooden Sleepers. As a result of the work and researches of Sir Ralph Pearson and others, carried on by successors, Forest Bulletin No. 85 (Delhi: Manager of Publications, 1934) has recently appeared entitled "A Record of the Results obtained with Experimental Treated Sleepers laid in Indian Railways between 1911 and 1916", by S. Kamesam of the Wood Preservation Section of the Research Institute at Dehra Dun. Between 1911 and 1916 some thousands of wood sleepers of several species of Indian timbers were treated with different preservatives at Dehra Dun and then laid down by the railway authorities in the various railway systems of India. As a result of these experiments, the confidence of Indian railway engineers in wood preservation has been steadily and definitely strengthened. Coal-tar creosote, as in other parts of the world, has given excellent results. The Indian railways are thoroughly satisfied with a creosote-crude oil treatment for their sleepers, and it has become the standard treatment during the last decade. In reviewing, however, the results obtained in the present series of test sleepers, and considering that creosote costs in India more than twice as much as it does in Europe, Mr. Kamesam states that there are great potentialities for cheaper preservatives, such as arsenic, on the basis of wood preservative "efficiency for a unit of cost". Tabular statements record the number of the sleepers laid in different parts of India (except the south), and give data as to the method of treatment and their subsequent life-history.

Pulsation in Electric Mains. We have now throughout Britain hundreds of very powerful dynamos (alternating current generators) all working practically in step with one another although the frequency is 50 per second. In the early days of electricity supply, John Hopkinson found mathematically that two alternators could run in parallel with one another, a slight falling out of step being accompanied by powerful forces tending to make them fall into step again. Practical experience has shown that instability may arise from the nature of the load, and if we have many machines working in parallel and interconnected by long mains, serious pulsations of the current may be set up which may open the circuit breakers and interrupt the supply. In a paper by W. D. Horsley read to the Institution of Electrical Engineers on March 28 an investigation is made of different conditions of operation which may give rise to these pulsations. The value of automatic voltage regulation is discussed and it is shown that it is of considerable value in increasing the load limit and stability of an alternator. When it is used, the load of the system is only limited by the values of the constants of the transmitting line. In America the corresponding problem is more difficult because the power stations have to be interconnected by very long transmission lines. In addition, they have large hydro-electric plants linked together with steam generating plants. In designing the British grid full advantage was taken of experience gained abroad. Luckily the lightning problem is not a serious one in Great Britain. The most severe types of disturbance we suffer from are due to faults in the network, and so the quicker the speed of operation of protecting apparatus and switch gear the better.

A Test Recorder for Electric Lamps. The manufacturer of incandescent lamps is obliged, in order to control the quality of his product, to make a large number of life tests of individual samples. In order to get the maximum benefit from these tests, they have to be made on a large scale under expert supervision. The large consumption of electric energy during the 1,200-hour test is quite a serious addition to the cost of manufacture of the lamp. It has now been found that by increasing the voltage applied over the rated voltage of the lamps, the time necessary for the complete test can be considerably shortened. For example, the life-history of a batch of lamps which would normally average 1,200 hours burning could be found in twelve hours. In the *G.E.C. Journal* of May, G. Chelioti gives a full description of the test recorder used by the Osram-G.E.C. works. This works has had considerable experience of the shortened method of testing, but before the introduction of the recorder it was found that the necessary continuous supervision for the 12-hour test put a great strain on the supervisors, as unless the time at which each of a long row of lamps burns out was recorded with fair accuracy, large errors arose. Human frailty is a large factor as the work is extremely monotonous, and it is practically impossible to check the records. Hence an electrical recorder which would relieve the worker of this dreary task and give a permanent record of unimpeachable authority was welcomed. In the full-life test at the rated voltage, it is customary to make checks every 12 hours; in the abbreviated test they are made every six minutes.

The David Dunlap Observatory, Toronto

ALTHOUGH most of the astronomers of Canada are graduates of the University of Toronto, hitherto the University has possessed no observatory This want has been recently supplied by the munificence of Mrs D A Dunlap, who has presented the University with a 74-inch reflecting telescope, as well as a handsome administrative building The inauguration ceremony took place on May 31, the chair being taken by the president of the University, Canon Cody, in the presence of the Lieutenant-Governor, Dr Bruce, Sir Robert Falconer (a former president of the University), Mr. Mackenzie King (a former Prime Minister of the Dominion), professors of the University, and astronomers from Great Britain, Canada and the United States, and a thousand interested visitors

After a dedicatory prayer by the Rev. E W. Wallace, Chancellor of Victoria College, the chairman read letters of congratulation from the president of the International Astronomical Union, the president of the Royal Astronomical Society of Canada, Sir James Jeans and Sir Arthur Eddington He then called on the architect, who handed a golden key to Mrs. Dunlap. She opened the door with the words, "In loving memory of my husband, David Alexander Dunlap, I now present this astronomical observatory to the University of Toronto, believing this memorial will express his deep interest in astronomy, and I hope through its equipment great advances will be made in the science", and handed the key to Dr. B M Macdonald, chairman of the Board of Governors.

After a warm expression of thanks by Dr Macdonald, a sincere tribute to Mr Dunlap was paid by him and by the Lieutenant-Governor The president then called on Prof. Chant, the director of the Observatory, and noted that the inauguration had been fixed on Prof. Chant's seventieth birthday Prof Chant referred to Mr. Dunlap's great interest in astronomy, and said that in 1926 he ventured to lay the project of an observatory in Mr. Dunlap's memory before her The foundation stone was laid in 1932 by Mr Moffatt Dunlap "To Mrs. Dunlap all the credit is due; were it not for her there would be no observatory here"

Mr Cecil Young, manager of the firm of Sir Howard Grubb, Parsons and Co., then gave an account of the large telescope and dome which were described and illustrated in an article in NATURE of October 14, 1933 Sir Frank Dyson gave the good wishes of the Royal Astronomical Society, and congratulated Prof Chant on the great interest in astronomy in Canada, which was in large measure due to him. Short addresses were given by Prof. H. D Curtis, director of the Observatory of the University of Michigan, Prof. V. Slipher, director of the Lowell Observatory at Flagstaff, Prof H. Shapley, director of the Harvard College Observatory, and Dr W. E. Harper, director in charge of the Dominion Observatory at Victoria

The Observatory is situated in 160 acres of ground on Richmond Hill, some twelve miles north of Toronto, from which a beautiful view extends in all directions It is sufficiently distant from Toronto to avoid smoke and glare, and yet near enough to the University. The number of good observing nights is estimated at about 120 in the year. The administration building is a handsome structure of stone, surmounted by three domes for smaller telescopes. It contains office and computing rooms, a library and well-equipped workshops The large telescope is in a steel dome with the necessary insulating material to diminish changes of temperature, and was constructed by Messrs Sir Howard Grubb, Parsons and Co The general appearance of the telescope in relationship to the dome is very satisfactory The clockwork and the electrical movements of the telescope and dome fulfil all requirements. The mirror of 74 inches is of pyrex, made by the Corning Company of New York. The grinding and figuring of the mirror were carried out at Newcastle, under Mr Cyril Young's direction, by Mr Armstrong, the very competent artist of the firm. The spectroscope was constructed by Messrs. Adam Hilger, Ltd., and is admirably adapted to determine velocities in the line of sight for which the instrument will be generally used. Telescope and spectroscope were thoroughly tested by Mr R. K Young. In Mr Young, Mr. Hogg and Mr. Millman, Prof. Chant has an able, experienced and enthusiastic staff. We may look with confidence for an excellent output of work from the David Dunlap Observatory.

F. W. DYSON.

Humoral Transmission of Nervous Impulses[*]

IN 1921 it was proved for the first time that the modifications of the heart's function, caused by stimulation of its nerves, are due to substances liberated by the stimulation, called transmitters: acetylcholine and an adrenaline-like body respectively, which in their turn bring about the effects of stimulation This 'humoral transmission of nervous impulses' occurs, not only in the heart, but also with stimulation of all the other vegetative nerves. Whether it also happens within the somatic nervous system is not yet settled.

The nerves releasing transmitters on stimulation do not influence the *function* of their effective organs otherwise than by this release. But we must attribute to them an influence—independent of the release of the transmitters—on the *sensitivity* of their effector organs to peripheral, directly applied stimuli.

The discovery of the humoral transmission of nervous impulses discloses the hitherto obscure mechanism of the effect of nervous stimulation in general, and also particularly of peripheral inhibition.

As to the point of attack of nervous stimulation, that is, the localisation of the release of the transmitters, there are two possibilities: either the nerve-ending or the effective organ. There are many arguments against the latter possibility, but the former is supported by the following: (1) after nerve degeneration, the transmitter disappears, even in cases in which the effective organ is not degenerated at all, (2) on stimulation of the preganglionic cervical sympathetic the transmitter is liberated, not within the ganglion cell, but at the synapse—in other words, from the nerve-ending. Regarding the *mechanism* of the release we have to consider also two possibilities: either the transmitter is newly formed by the nerve-stimulation, or it is made diffusible, being split off from a combination already present in the nerve-ending. The decision between these alternatives cannot yet be made.

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[*] Substance of the Ferrier Lecture delivered by Prof. Otto Loewi, professor of pharmacology in the University of Graz, before the Royal Society on June 20

The lapse of time between the nerve-stimulation and the response of the reacting organ is extremely short, even in organs like the heart, where the transmitter has to pass a certain distance in order to reach the effector cells. The transmitters disappear somewhat quickly, the time of disappearance being dependent on the type of action which they have to produce.

The point of attack of the transmitters is not a part of the neurone, but the functioning, effective organ itself. The fact that the transmitters, when artificially injected, mainly act at points in relation to which they are normally liberated, can be given, as yet, only a teleological interpretation. Since the transmitters can diffuse into the blood from the point of their release, they can, in principle, also affect remote organs, though under physiological conditions this may never happen. Obviously such a distant action is unnecessary, as such needs are fulfilled by the hormones.

Finally, the question is considered whether the difference between the action of the hormones and that of the transmitters concerns only the sphere or also the character of their action. The hormones of two of the ductless glands, both being neurotropic and differing from all other ductless glands by properties common to them only—the adrenal medulla and the posterior lobe of the hypophysis—initiate or modify, according to need, the specific *function* of the organs, as the nerves or the transmitters do.

All the other ductless glands are not neurotropic; they depend largely on the anterior lobe of the hypophysis regarding their development and state; their secretion is going on continuously and automatically, though partly controlled by the nervous system. Their action is concerned less with the *specific functions* of organs than with *general conditions*—state and metabolism. In other words, there are differences not only regarding the sphere but also regarding the character of the action of the nerves and the transmitters, on one hand, and that of the hormones on the other.

Cosmic Ray Results of the American Stratosphere Balloon *Explorer I*

BRIEF accounts have been given in NATURE[1] of the flight of the American stratosphere balloon *Explorer I* and the subsequent mishap by which it was at first feared that most of the valuable photographic records had been destroyed. Subsequent expert development of the films shows that, whilst the whole of the objectives have not been secured, those records that have been saved have yielded interesting and confirmatory results to collateral researches.

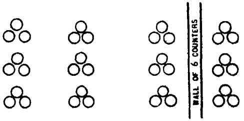

FIG 1

Swann and Locher have contributed an article on "The Variation of Cosmic Ray Intensity with Direction in the Stratosphere", and Millikan a short article on the results of the flight in "Stratosphere Series, No. 1" of the U.S. National Geographic Society. In the former of these researches, as many as 168 Geiger-Müller counters were employed. These were disposed as in Figs 1a and 1b. In each case three counters close together form a unit, and corresponding ones of the nine counters on either the right or duplicate left side of Fig 1a must be influenced for a count. There were four such banks for the directions 0°, 30°, 60° and 90° to the vertical. In Fig. 1a, the counters are in the 0° position. The whole system was now duplicated as in Fig. 1b, with the addition of a wall or partition of six *neutralising* counters dividing each bank. Apart from the influence of this wall on the time resolution, the arrangement of counters in Fig 1b would have the greater directive tendency. Two systems of recording were employed, one in which the total number of counts in a given time was integrated, and the other in which each individual count was recorded and timed. The curve of the spatial distribution of the rays at an altitude of 40,000 ft. for the two arrangements of the counters is shown in Fig 2, in which the curve *a* corresponds to the arrangement of Fig 1a and the curve *b* that in Fig. 1b. The number of counts varies from about 5 per minute for rays from the horizontal direction to about 20 per minute from the vertical at this height, whilst the more recent results from a flight by J. Piccard in America give similar curves up to 53,000 ft. The dotted curve *a*, which includes

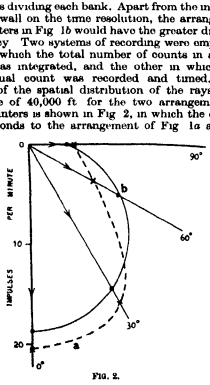

FIG. 2.

showers as well as individual rays, seems to show that the showers, on the whole, tend to come from the zenith.

When the average curve is integrated over a hemisphere and compared with a similar integration at sea-level, the ratio of the counter actions at the two heights is 64. Millikan's result with a thin-walled ionisation chamber at 40,000 ft. is $J = 250$ ions per c.c. per sec., so that if counter action is to be compared directly with volume ionisation by cosmic rays, the value of J at sea-level would be $250/64 = 3\cdot9$ ions per c.c. per sec. As against this value for J three direct determinations are quoted, namely, Millikan 2·4, Compton 1·9, Hoffmann 1·0. Comparison of the mean of these three figures with 3·9 indicates that counter action does not increase at the same rate with altitude as volume ionisation in a given locality. This is generally taken to mean that there is an increasing admixture of particles in higher altitudes that will not penetrate the counters but that will penetrate the walls of the ionisation chamber.

The Neher recording shielded electroscopes were destroyed in the crash, but an unshielded one gave a record up to 60,000 ft. The result for J agrees with that of the Fordney Settle flight of November 1933.

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[1] NATURE, 134, 132, July 28, 1934; 707, Nov. 3, 1934; 135, 299, Feb. 23, 1935.

Surface Chemistry and its Industrial Applications

FEW industries are not dependent, at some stage in their processes, on reactions between matter in different states of aggregation, and consequently few industrial chemists can afford to ignore the recent developments in our knowledge of the physical and chemical changes that occur at surfaces. It is not surprising, therefore, that there was a record gathering for the discussion on the theoretical aspects and industrial applications of surface chemistry arranged by Section B for the Melbourne Centenary meeting of the Australian and New Zealand Association for the Advancement of Science. Prof. J. C. Earl was sectional president.

Dr. T. Iredale, opening the discussion, reviewed recent advances in the theory of surface chemistry, and other theoretical papers were presented by Dr. J. E. Mills on "The Recombination of Atoms and Free Radicles at Surfaces" and Dr. N. S. Bayliss on "A Critical Review of the Parachor". The contention that the parachor is of little value in determining the constitution of organic compounds was supported by Dr. R. A. Robinson. Mr. R. S. Burdon discussed the influence of carbon dioxide and hydrogen on the surface tension of mercury. Measurements of the amount of gas liberated by decreasing the surface area of a mercury surface prove that it adsorbs a unimolecular film that is tenaciously held, even in high vacuum. Prof. E. J. Hartung and the staff of the Chemistry Department of the University of Melbourne prepared a remarkably clear film of the Brownian movement in colloidal solutions. This film demonstrated the disintegration of benzopurpurin, the coagulation of copper ferrocyanide by sunlight, and the electrophoretic movement of the particles in either direction as the polarity of an applied electrical field was reversed. With a screen magnification of 40,000, the translational, vibrational and rotational movements of colloidal particles were clearly seen.

Papers dealing with industrial applications of surface chemistry were delivered by Mr. C. Blazey on "The Effect of Service Conditions on Metal Surfaces", Mr. A. R. Hogg on "The Contact Process for Sulphuric Acid" and Mr. J. S. Wilson on "A Résumé of Current Theories of the Process of Dyeing Textile Fibres". No single theory of dyeing has yet been able to explain how the various types of dye are taken up silk, cotton and wool fibres.

At a joint discussion with Section H on "Corrosion", papers were delivered by Prof. J. N. Greenwood on "The Combined Influence of Stress and Corrosion on Metals", Prof. A. Burn on "Cavitation in Turbines and Centrifugal Pumps", Dr. G. A. Elliott on "The Passivity of Metals in relation to Corrosion", Mr. P. F. Thompson on "Modern Theories of the Corrosion of Metals", Mr. C. J. Griffiths on "Electrolytic Corrosion" and Mr. V. Wardell on "Inhibitors of the Acid Corrosion of Metals". Mr. Wardell, discussing the cleaning of iron for galvanising, enumerated a great variety of substances that, though not preventing the removal of scale by acids, greatly reduce or even prevent the dissolution of iron. Glue is commonly used for this purpose. Generally known as inhibitors, these substances are used also for cleaning boilers and water mains. The addition to hydrochloric acid of a little arsenic chloride, while preventing dissolution of the steel base of galvanised iron, does not seriously retard the solution of the zinc coating.

Most of Australia's secondary industries, being still in the early stages of development, are forced to concentrate upon the solution of purely local problems. The base metal mining industry, however, grateful for benefits from the research work of other countries has, with the co-operation of the University of Melbourne, established a research laboratory for the investigation of the fundamental physico-chemical principles underlying the flotation process. Mr. H. Hey, opening a discussion on the chemistry of flotation, outlined its development from the laboratory stage, through the original large-scale operations at Broken Hill, to its present world-wide application to a great variety of ores. Mr. A. B. Cox and Dr. Ian W. Wark then described the work of the University laboratory. The flotation of a mineral depends upon its surface being modified so that it will adhere to an air bubble. Contact angle gives a quantitative measure of the condition of the surface. The influence of the adsorption of various organic compounds known as *collectors* on the magnitude of the angle of contact, and the influence of several inorganic compounds on their adsorption, have been determined. It is concluded that a unimolecular orientated adsorption of the collector is responsible for the attachment between mineral and air bubble. There is not yet agreement as to the mechanism of adsorption.

At a luncheon given by the Australian Chemical Institute, Dr. T. Callan conveyed greetings to the chemists of Australia from the Institute of Chemistry of Great Britain and Ireland and from the Society of Chemical Industry.

University and Educational Intelligence

CAMBRIDGE.—The following appointments have been made: E. Farmer, of Trinity College, reader in industrial psychology; E. G. Chalmers, of Clare College, assistant director of research in industrial psychology; P. Graffa, of King's College, assistant director of research in economics; Dr. J. K. Roberts, of Trinity College, assistant director of research in colloid science; Dr. W. A. Wooster, of Peterhouse, lecturer in mineralogy and petrology; E. T. C. Spooner, of Clare College, lecturer in pathology; G. C. Grindley, lecturer in experimental psychology; N. Dean, of Trinity Hall, lecturer in estate management; C. Culpin, of St. John's College, demonstrator in agricultural engineering; Dr. J. D. Cockcroft, of St. John's College, lecturer in physics; P. I. Dee, of Sidney Sussex College, lecturer in physics; Miss A. C. Davies, of Newnham College, lecturer in physics; Dr. M. L. E. Oliphant, of St. John's College, assistant director of research in physics; Dr. W. B. Lewis, of Gonville and Caius College, demonstrator in physics.

Prof. E. V. Appleton, Wheatstone professor of physics, King's College, London, has been appointed Scott Lecturer for the year 1936–37.

H. McCombie, of King's College, has been approved for the degree of Sc.D.

Dr. C. S. Myers has been elected to an honorary fellowship at Gonville and Caius College.

EDINBURGH.—The first Sharpey-Schafer Memorial Lecture, given on June 21 by Sir Charles Scott Sherrington, was a notable tribute paid to the late distinguished physiologist by his fellow-worker and friend. Sir Charles referred more particularly to Sir Edward Sharpey-Schafer's work in endocrinology and in neurology, and dwelt on the great interest and importance of the observations made by Schafer in 1877 on the nerve-elements in the jelly-fish *Aurelia*, and in his later work on localisation in the cerebral cortex and on the structure of the spinal cord.

Dr. C. G. Anderson has been appointed Lewis Cameron teaching fellow in the Department of Bacteriology. This is the first appointment under the scheme recently approved by the Court of Session for the administration of the Lewis Cameron Fund.

LEEDS.—Prof. Stroud has given £1,000 towards the Union building, and £100 for the Physics Museum.

Prof. J. H. Priestley has been appointed Pro-Vice-Chancellor of the University for a period of two years from July 1.

Mr. B. H. Wilsdon, director of the British Wool Research Association, has been appointed director of research students at Torridon under the scheme of co-operation between the University and the Association.

LONDON.—Dr. H. L. EASON, superintendent and senior ophthalmic surgeon of Guy's Hospital, has been elected Vice-Chancellor for the year 1935–36, and the Rev. H. B. Workman has been appointed Deputy Vice-Chancellor for the same period.

The Right Hon. Lord Hanworth, the Master of the Rolls, has been appointed Creighton Lecturer for the year 1935–36. The lecture, entitled "The Preservation of our Archives, National and Local", will be delivered at the London School of Economics during the Michaelmas term.

OXFORD.—The Johnson Memorial Prize for 1935 has been awarded to Dr. T. G. Cowling, Brasenose College, at present lecturer in mathematics at the University College of Swansea. The prize consists of a gold medal of the value of ten guineas, together with a sum of money. It is awarded once every four years for an essay on some astronomical or meteorological subject. It is understood that Dr. Cowling's essay was entitled "Convection in Stars".

ST. ANDREWS.—At a meeting of the University Court held on Saturday, June 22, the following appointments to vacant chairs in University College, Dundee, were made:—*Mathematics*: Dr. E. T. Copson, Royal Naval College, Greenwich; *Physiology*: Dr. Robert C. Garry, Rowett Research Institute, Bucksburn, Aberdeen.

PROF. J. GRAHAM KERR, F.R.S., regius professor of zoology in the University of Glasgow, has been elected M.P. for the Scottish Universities. The by-election was caused by the appointment of Lord Tweedsmuir (formerly Mr. John Buchan) as Governor-General of Canada. The voting was: Prof. J. Graham Kerr (Nat. Govt.), 20,507; Mrs. N. Mitchison (Lab.), 4,293. As remarked in a note referring to Prof. Graham Kerr's candidature in NATURE of June 1, p. 919, his election involves giving up the life tenure of his professorial chair.

Science News a Century Ago

Middlesex Hospital Medical School

Sir Charles Bell (1774–1842), the surgeon, writing to his brother George Joseph Bell (1770–1843), the lawyer, on June 29, 1835, said:

"My dear Brother,

"We have founded a school in the garden of the Middlesex Hospital. The building will be a complete little thing—theatre, museum, clinical class-room and dissecting room. But you must admire my spirit to commence such an undertaking at this day. I promise to the extent of sixty lectures. To the work I have no objection, but there will be a great outlay also, although from the way in which it is taken by the governors, I believe subscriptions will cover all expenses. The building will cost £2,400."

Writing again on July 22, he said: "Would you believe that our school is already roofed? It seems like magic. We pay for that, however. But for dispatch we might have had it built for much less."

Locomotives on the Liverpool and Manchester Railway

Quoting from a paper read by Mr. David Stevenson to the Scottish Society of Arts, the *Mechanics' Magazine* of July 4, 1835, said: "The Liverpool and Manchester Railway locomotive-carriages are of three kinds, and are called train, luggage and bank engines. The train-engines average about 30 horses' power; they weigh about 8 tons, and cost about £900. The luggage-engines are in general, 35 horses' power, and weigh about 9 tons; they cost about £1,000. There are only two bank-engines, the *Goliath* and *Samson*, which are used for assisting the trains up the inclined planes at Whiston and Sutton; they are about 50 horses' power, weigh about 12 tons and cost about £1,100. The Company has had altogether 32 locomotive-carriages made. . . The *Vulcan*, a train engine, ran no less than 47,000 miles before it required to be repaired; and the *Firefly* ran 50,000 miles. The greatest speed which the engines have been able to obtain on a level is 60 miles per hour, without a load "

Death of Sir Edward Banks, 1770–1835

On July 5, 1835, Sir Edward Banks died at Tilgate Lodge, Sussex, and a few days later was buried at Chipstead, Surrey, where both his tomb and monument are to be seen Born near Richmond, Yorkshire, on January 4, 1770, in a humble station of life, Banks raised himself to the highest position among civil engineering contractors, and "during 40 years was engaged on the erection of some of the most useful, extensive and splendid works of his time". His earliest experience was gained in canal construction in the north of England, partly under John Rennie and William Jessop. Probably through the latter he became connected with the Surrey Iron Railway from Wandsworth to Merstham, and was thus brought into contact with the land-owning family of Jolliffe at Merstham In 1807 he entered into partnership with the Rev William John Jolliffe (1774–1835), who abandoned the Church for engineering, and the partners were soon engaged on a succession of important works, which included the Waterloo, Southwark, London and Staines Bridges over the River Thames They also carried out contracts in connexion with the ports of Howth and Goole, Deptford and Sheerness Dockyards, and with the improvement of the Rivers Nene, Witham and Ouse The bridge over the Serpentine, Hyde Park, was built by them in 1824 On June 12, 1822, Banks was knighted for "the extraordinary exertions, industry, skill and perseverance he had displayed in the execution of the Waterloo and Southwark Bridges", this being the first instance of this honour being bestowed on a professional engineer.

Alphonse De Candolle's Treatise on Botany

Among the natural history works of lasting interest published in 1835 was the "Introduction à l'etude de la Botanique ou Traité Elementaire de cette Science" of Alphonse De Candolle, professor at the Academy of Geneva A review of this work appeared in the July issue of the *Records of General Science*. "This work," said the review, "may therefore be considered the most complete treatise which has appeared on the subject, and it is written with great precision and clearness. It exhibits a great extent of botanical knowledge, and is accommodated to the present state of the science,'as the author states the opinions brought forward in the most recent European works of botany, and candidly adopts those which appear to him of most weight. . . . The most curious and novel part of the work is that which relates to botanical geography. The most imperfect part of the work is that which treats of the superior phenomena, which escape our physical explications, and which depend on unknown powers, which we are in the habit of designating by the obscure name of vital powers, because they are connected with the preservation and permanence of the species . . . The explanation of all these phenomena, and many others, will, however attract the attention of botanists, and sooner or later, we may expect them to be elucidated."

Societies and Academies

DUBLIN

Royal Dublin Society, May 28. W. J. LOOBY and J. DOYLE Fertilisation and pro-embryo formation in *Sequoia*. Fertilisation takes place in Irish material of *Sequoia gigantea* in August of the first year, being rapidly followed by pro-embryo and early embryo development. The embryo is not completed until the secon year, the winter being passed in the embryo-with suspensor stages. The pro-embryo only occupies th lower part of the archegonium, with wall formation at the eight-nuclei stage, the complete pro-embry showing a 2 – 6 – 6 or a 3 – 5 – 5 arrangemen *Sequoia sempervirens*, though forming a wall at th first division of the fusion nucleus as already recorded leaves unused protoplasm at the top of the archegonium, the pro-embryo frequently occupying only one half of it. E J SHEEHY Note on the effect o storage on the colour and on the free fatty acid content of a commercial sample of veterinary cod liver oil Slight hydrolytic and very considerabl oxidative changes occurred in veterinary cod live oil stored under different conditions Colour changes associated with increased free fatty acid content, and induced by contact with the material of the container, occurred. REPORT OF THE IRISH RADIUM COMMITTEE FOR THE YEAR 1934. This include reports submitted by medical users of radon supplie by the Committee, and records the treatment o 441 malignant and 149 non-malignant cases Thi is a considerable increase over the total number (466 recorded in the 1933 report. A tendency towards th use of smaller doses has, however, reduced the tot quantity of radon issued from 12,996 mC in 1933 t 11,744 mC in 1934.

EDINBURGH

Royal Society, June 3. T NICOL. Studies on th female reproductive system in the guinea pig intravitam staining; fat production, influence hormones Special cells showing maximum amoun of trypan blue occur in the endometrium only large numbers at certain stages of the sexual cycl and are practically absent in sexually immatu animals. This condition, absent in ovariectomis animals, was produced by œstrin injections, but by administration of corpus luteum hormone or terior pituitary The fat deposit also appeared cycl and was produced artificially in ovariectomise animals by injection of corpus luteum extract, aft sensitisation with œstrin. In the pregnant anim around the embryo, cells, proved endometrial development, absorb the dye and form embryotroph The results as a whole indicate that the function cells absorbing the dye is histiotrophic. G. BON The endodermis in light-grown and etiolated shoo of the Leguminosæ: a contribution to the cau study of differentiation in the plant. Priestley observations on the promoting effect of etiolati upon differentiation of primary endodermis in t shoots of various members of the Leguminosæ ha been confirmed and extended in the present wor Light appears to be the particular environment factor responsible for the non-development of endodermis in these shoots under normal growt conditions In other leguminous plants, the effe of etiolation was less marked. The developme under normal conditions of the basal endodermis in *Vicia Faba*, etc., does not appear to be entirely due to the differentiation of the first internodes in darkness occasioned by the soil or by the presence of the cotyledons. The initial development of these internodes in the darkness of the ovary may also be responsible. **R. A. ROBB** and **T. R. TANNAHILL**: Lunar atmospheric inequality at Glasgow. An analysis of the Glasgow Observatory hourly barograph records, 1868–1912, rearranged according to lunar ime, shows that there are significant diurnal and emi-diurnal variations of pressure, for the 4,290 days considered, during which the daily range of pressure did not exceed 0·1 in of mercury, the variations can be represented by 0 0640 sin (θ − 267°) millibar, and 0·0156 sin (2θ − 285°) millibar The data were also subdivided in various ways as in Prof Chapman's investigation of a similar nature All subdivisions show characteristics similar to those for the total data as given above

PARIS

Academy of Sciences, May 13 (*C R*, 200, 1641–1696). **ALFRED LACROIX**: Stony meteorites fallen in Air (Niger Colony) The examination of meteorites found 95 kilometres apart indicates that these had a common origin **EMILE MATHIAS** The diameter of the curve of densities **EUGÈNE BLANC** The idea of distance. **PAUL ALEXANDROFF**. Discrete spaces **GEORGES GIRAUD**: Certain operations of the elliptic type **G MIHOC**: The determination of the contraction interval of the formula of the mean **BERNARD KWAL**. Some remarks on the electrodynamics of Born and Infeld **JEAN VILLEY**: The classification of the energy losses according to the rôle of the irreversible operations. **B ROSEN** and **M DÉSIRANT** The emission spectrum of the molecule CSe. **JEAN TIMMERMANS** and **LOUIS DEFFET** Experimental researches on the physical constants of heavy water. The variation of the melting point as a function of the pressure The fusion curve of heavy water is ractically parallel to that of water, although its inclination is slightly less No evidence has been found of the existence of polymorphic forms **ROBERT TRÉHIN** and **BORIS VODAR** The absorption spectrum of liquid hydrogen chloride in the extreme ultraviolet **HENRI TRICHÉ**: The quantitative spectrum nalysis of calcium and barium in light alloys and in solutions, and various influences on the emission of the lines. **ADRIEN KARL**. Zirconium pyrophoshate Study of the properties of zirconium pyrophosphate from the point of view of separating zirconium from iron and titanium **M. BACKÈS**: The onstitution of the aldols. **PAUL GOLDFINGER** and **WLADIMIR LASAREFF**. The reaction of the amines with heavy water. The results tend to prove the accuracy of the ordinary formula for the amines as opposed to that suggested by J. Thomsen. **CHARLES UFRAISSE** and **MAURICE LOURY**: Research on the issociable organic oxides. 1,1-Diphenylrubene, $C_{42}H_{28}$. the thermal decomposition of its photoxide, $C_{42}H_{28}O_2$. This diphenylrubene is the first of the photoxides of this group which is not dissociable; on heating, it forms a red resin without evolution of xygen. **MARCEL ROMET**: The synthesis of the t[illegible] inoline bases starting with oxymethylene derivatives of ketones. **JEAN LOMBARD**: Conclusions of a lithological study of the crystalline schists of central Oubangui-Chari. **ARTHUR STOLL** and **ERNEST BURCKHARDT**: Ergobasine, a new alkaloid from ergot of rye, soluble in water. This alkaloid has the formula $C_{19}H_{22}O_2N_3$ and on account of its solubility in water and slight solubility in chloroform can be easily purified **RENÉ MARTIAL**: The cephalo-hæmatic parallelism and its consequences from the point of view of race **ALPHONSE LABBÉ**. A new function of the coupling organ of the Silicoderms. **ROBERT WEILL**: The division of anucleated and highly differentiated cellular elements: the multiplication, by fission, of the colloblasts of *Lampetia pancerina* **JULES AMAR** The regeneration of the nails **CAMILLE CHARAUX** and **JACQUES RABATÉ** Persicoside A glycoside isolated from the bark of the peach tree, the β-glycoside of hesperetol, $C_{22}H_{24}O_{11}$ **AUGUSTE** and **RENÉ SARTORY**, **JACQUES MEYER** and **FRÉDÉRIC ARNOLD** Preliminary study in defined synthetic media of the cultural factors necessary for determining the fertility of the soil by means of *Sterigmatocystis nigra* **CONSTANTIN LEVADITI** and **ARON VAISMAN**. The curative and preventive action of 4′ sulphamido-2,4 diaminoazobenzene in experimental streptococcic infection.

AMSTERDAM

Royal Academy (*Proc*, **38**, No 5, April 27, 1935). **H R KRUYT**. Action of electrolytes on hydrophobic colloids To explain the action of electrolytes on a sol it is necessary to distinguish between those ions which are potential-determinative and those which are not **J. LE HEUX** and **A DE KLEYN** Reaction of the eye muscles to two simultaneously applied stimuli, together with a contribution to the question of the labyrinthine genesis of miner's nystagmus **A PANNEKOEK** and **S VERWEY** The Stark effect of hydrogen in early type stellar spectra The profiles of the hydrogen lines depend largely on the surface gravity and allow of a certain identification of white dwarf stars **W H KEESOM** and **MISS A P. KEESOM** New measurements on the specific heat of liquid helium New measurements at 19 and 25 atmospheres pressure. **W H. KEESOM** and **C W. CLARK**: The atomic heat of nickel between 1 1 and 19·0° *K* There is a large heat capacity above that calculated from Debye's law which is given by $C = 0\ 001744\ T$. **L S ORNSTEIN** Mean values of the electric force in a random distribution of charges **A A NYLAND** Mean light-curves of long-period variables (23) *X* Aurigæ. The light of this star varies with a period of 163 days and an amplitude of 4·21 magnitudes **F M JAEGER**, **R FONTEYNE** and **E ROSENBOHM**: The exact measurement of the specific heats of solid substances at higher temperatures (18) On the use of Dewar vacuum vessels for the control of the cooling rate **T. J POPPEMA** and **F M JAEGER** The exact measurement of the specific heats of solid substances at higher temperatures (19) The specific heats of zinc, magnesium and their binary alloy $MgZn_2$. The molecular heat of $MgZn_2$ is less than that calculated by assuming the atomic heats of the constituents are additive **W HUREWICZ**: Contributions to the topology of deformations (2) Homotopy and homology groups. **C. S. MEYER**: Some further integral representations of the Whittaker function. **P. E. VERKADE**, **J. VAN DER LEE** and **K. HOLWERDA**: Researches on fat metabolism (6) Experiments with α-lauro-βγ-diundecoylin. In the alimentary tract the two fatty acids are liberated at the same rate from α-lauro-βγ-diundecoylin and from the corresponding mixture of trilaurin and triundecoylin. **W. J. ROBERTS**: A new procedure for the detection of gold in animal tissues physical development Detection of gold in animal tissues by physical development in a solution of gum arabic silver nitrate hydroquinone and citric acid Miss M A Kennard Clinical and histological observations on a case of primary cortical degeneration of the cerebellum A case of progressive ataxia showed complete degeneration of th Purkinje cells of the cerebellum A de Buck and N H Swellengrebel Further studies on and discussion of the results of cross mating the races (varieties) of *Anopheles maculipennis* Crossing experiments with *Anopheles* from Sweden and Holland showed that the varieties were identical in the two countries H J MacGillavry Remarks on Rudists

SYDNEY

Royal Society of New South Wales, May 1 R J Noble Some aspects of problems associated with the preservation of health in plants (presidential address) Reference was made to early records of the occurrence of plant diseases in New South Wales and to the urgent need for more general adoption of established measures of control in order that there might be greater stability in agricultural production The conditions of health and disease are not always readily differentiated Submerged infections delayed development of symptoms and virus masking are phenomena of academic interest and practical importance Variability and plasticity of host and pathogen and the significance of factors in the environmental complex were discussed Synergic and antibiotic phenomena are being more widely recognised in local problems Climatological factors were reviewed in relation to plant quarantine and spray forecasting services Virus diseases were discussed in relation to plant responses and the question was raised as to whether any groups of symptoms are comparable physiologically with those resulting from other causes

ROME

Royal National Academy of the Lincei, March 17 T Boggio Integration of Helmholtz s hydrodynamic equations A direct integration of these equations to obtain Cauchy s integrals is given F Tricomi The inversion of Laplace s transformation B Manià Conditioned problems of the calculus of variations R L Gomes The deduction of Lorentz s formulæ D Graffi The effect of a variation in mass on a planetary orbit R L Gomes Considerations on the fundamental equation of Louis de Broglie's "New Conception of Light" L Sobrero Functions analogous to potential in mathematical physics G R Levi and D Ghiron Action of arsenic acid and arsenates on hydrogen peroxide In small proportions arsenic acid has a stabilising action on hydr[illegible] peroxide but at higher concentrations the ion AsO[illegible] exhibits a specific decomposing effect L Musajo Investigations on xanthurenic acid (2) The results of experiments in which various animals were fed with fibrin show that, with the albino rat or rabbit, xanthurenic acid, quinurenic acid and quinurenin are eliminated in the urine and with the dog quinurenic acid and quinurenin without xanthurenic acid L Musajo and F M Chiancone Investigations on xanthurenic acid (3) genesis of the acid In the rat, xanthurenic acid is formed from tryptophane, probably with intermediate formation of quinurenin

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*

Sunday, June 30

British Museum (Natural History) at 3 and 4 30 — Miss M R J Edwards Protective Colouring and Mimicry * •

Museums Association July 1–4 Forty sixth Annual Conference to be held in Brussels

Society of Chemical Industry July 1 6 Fifty fourth annual meeting to be held in Glasgow

July 2 at 10 45 —Edwin Thompson National Water Supplies

At 3 —Commander J L Bedale Some Problems in Chemical Engineering which arise in H M Navy

July 3 at 9 30 Sir Harold Hartley and Dr A J M Smith *How Food is Transported by Rail and Sea'*

July 4 at 10 —Dr F E Armstrong The Past the Present and the Future (also presentation of the Medal of the Society to Dr Armstrong)

University of Bristol July 2 5 Conference on Some Aspects of the Metallic State to be held in the H P Wills Physical Laboratory

Official Publications Received

GREAT BRITAIN AND IRELAND

The British Science Guild Engineers Study Group on Economics First Interim Report on Schemes and Proposals for Economic and Social Reforms Pp 44 1*s* The Annual Report of the Council of Management 1934 1935 presented at the Annual General Meeting held at the Royal Society of Arts London on Wednesday 12th June 1935 Pp 23 1*s* (London British Science Guild)

Home Office Reports of the Poisons Board in regard to the Poisons List and Draft Poisons Rules prepared in accordance with the Pharmacy and Poisons Act 1933 (Cmd 4912) Pp iv+62 (London H M Stationery Office) 1*s* net

Transactions of the Royal Society of Edinburgh Vol 58 Part 2, No 14 The Anatomy of the Adhesive Apparatus in the Tadpoles of *Rana afghana* Günther with Special Reference to the Adaptive Modifications By Jnanendra Lal Bhaduri Pp 339 349 + 1 pla (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) 1*s* 9*d*

OTHER COUNTRIES

Nyasaland Protectorate Geological Survey Department Colonial Development Water Supply Investigation Progress Report (No 4) for the Year 1934 Pp 16 + 3 plates (Zomba Government Printer) 2*s* 6*d*

Report for the Year 1934 of His Majesty s Astronomer at the Cape of Good Hope to the Secretary of the Admiralty Pp 13 (Cape of Good Hope Royal Observatory)

Memoirs of the Asiatic Society of Bengal Vol 9 No 7 Geographic and Oceanographic Research in Indian Waters Part 7 The Topography and Bottom Deposits of the Laccadive Sea By Lieut Col R B Seymour Sewell Pp ii+425–460+plates 9–10 (Calcutta Asiatic Society of Bengal) 2 13 rupees

Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser Serie Fiskeri Bind 10 Nr 1 Cod Marking Experiments in the Waters of Greenland By Paul M Hansen Ad S Jensen and Å Vedel Tåning Pp 119 (København C A Reitzels Forlag) 3 00 kr

Ceylon Part 4 Education Science and Art (F) Administration Report of the Director of the Colombo Museum for 1934 By A H Malpas Pp F26 (Colombo Government Record Office) 25 cents

Whither Public Relations Work ? An Examination of the Development and Sociologic Aspects of Public Relations Technics By William A Hamor Pp 24 (Pittsburg Pa Mellon Institute of Industrial Research)

Summary Proceedings of the Twenty ninth Meeting of the Indian Central Cotton Committee Bombay held on the 28th and [illegible] August 1934 Pp 129 (Bombay Indian Central Cotton Committee

The Indian Forest Records Vol 20, Part 16 A Stand Table for Sal (*Shorea robusta*) evenaged High Forest and Coppice. Pp 18 (Delhi Manager of Publications) 12 annas 1*s* 3*d*

CATALOGUES

Botany Gardens and Gardening Agriculture and Herbals (Catalogue No 588) Pp 36 (London Francis Edwards, Ltd)

B D H Chlorotex Outfit for Determination of Free Chlorine Drinking Water and Swimming Pools Pp 12 (London The British Drug Houses Ltd)

Cambridge Thermo Electric Pyrometers for Temperatures up 1400° C. Pp 6 (London Cambridge Instrument Co Ltd)

Temperature Humidity and Pressure Controllers (List No R/ Pp 64 (London Negretti and Zambra)

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